Non-Commercial Fisheries in the Central and Western Pacific: A Summary Review of the Literature

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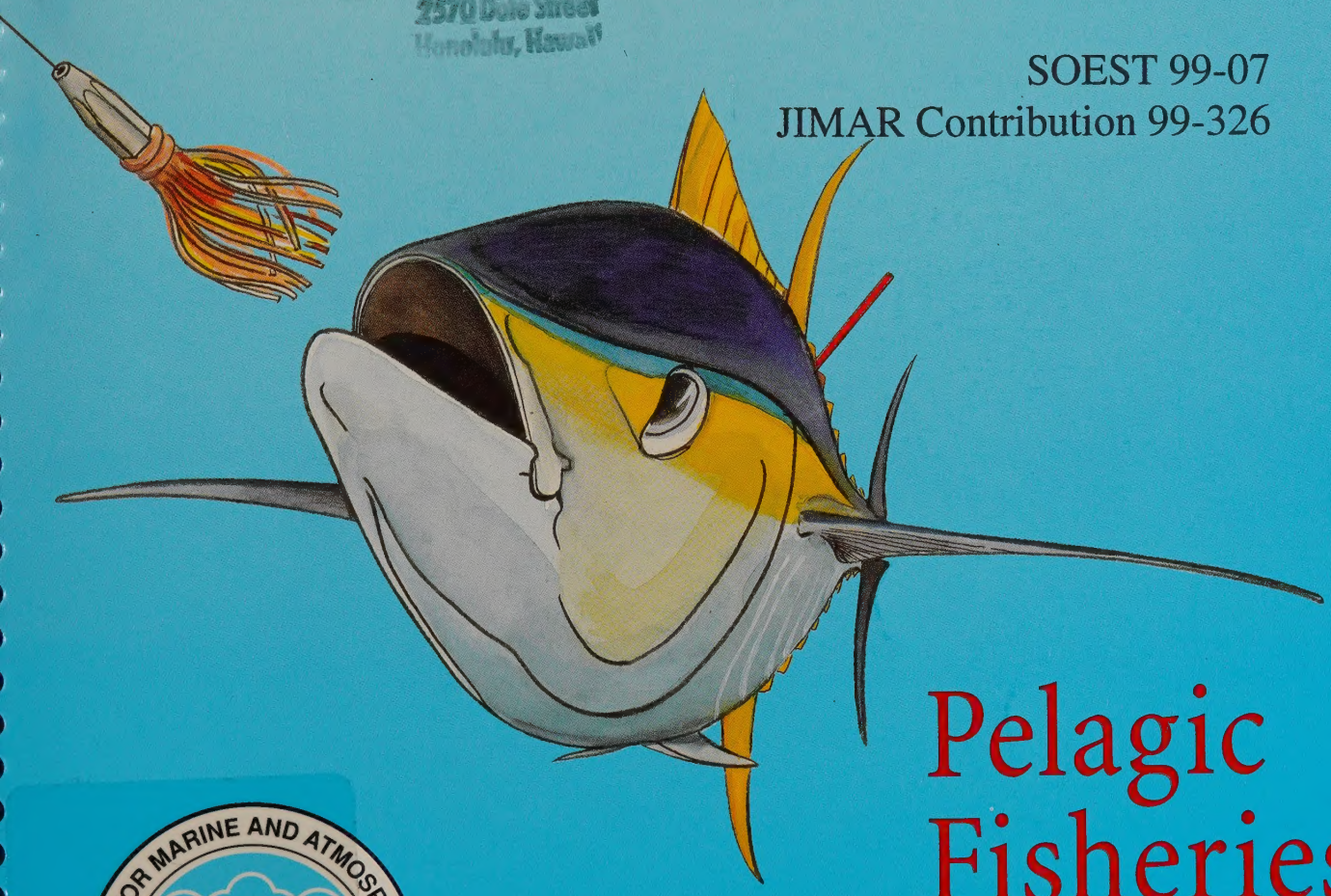

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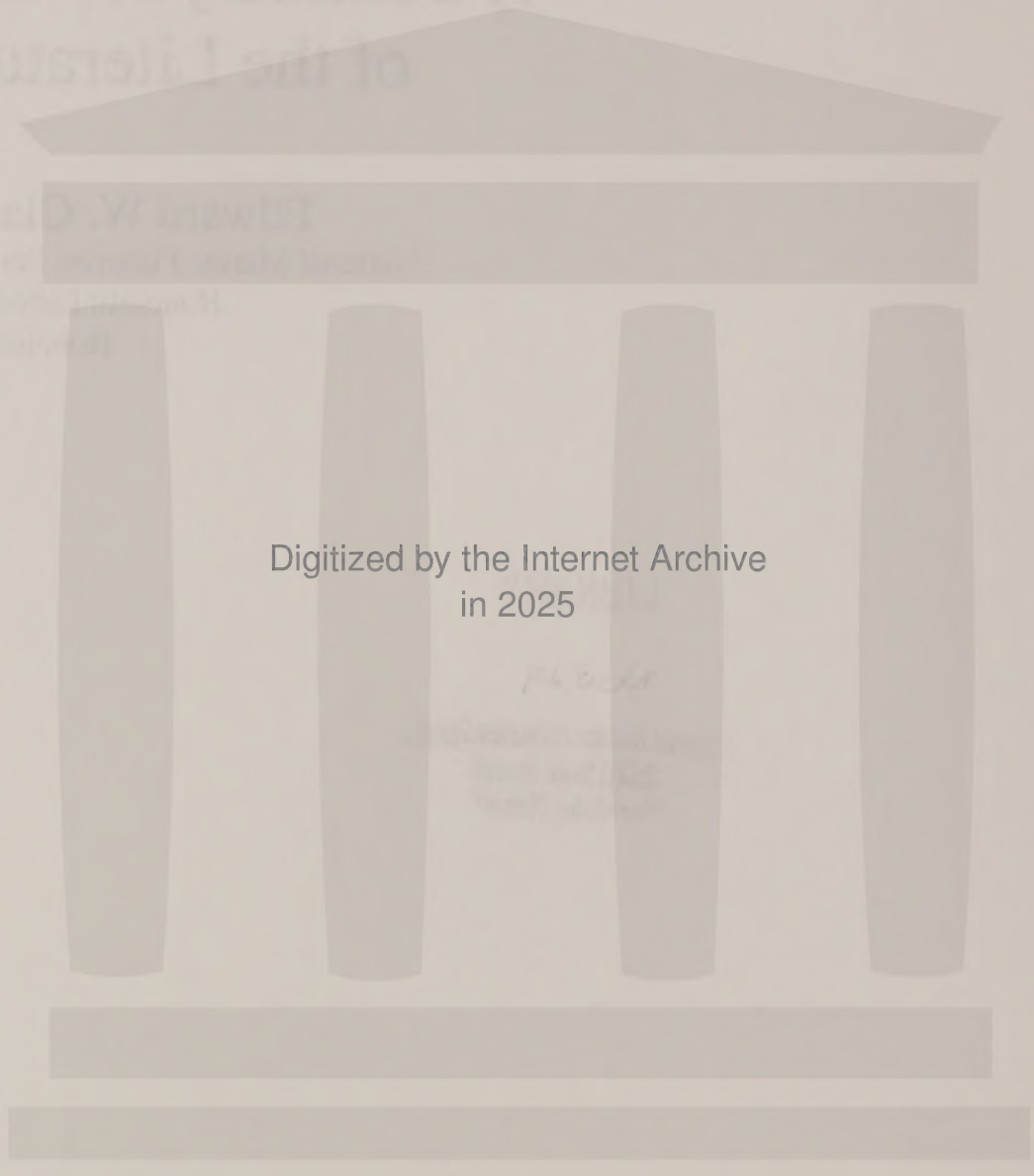

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Preface

This report reviews various articles, papers, technical reports, and other manuscripts addressing selected aspects of non-commercial marine fisheries in Hawaii, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. The review is intended to meet informational needs of the nascent statewide Recreational Fishing Task Force implemented by the Western Pacific Regional Fishery Management Council (WESPAC) toward improved understanding of non-commercial fishing activity and catch reporting in the region's nearshore and offshore waters. The review highlights economic and social aspects of the fishery, with some attention to its biological aspects, but given broad variation in the kinds of materials examined, some breadth of analytical focus is required. In all cases, the review addresses the research methods and analytical techniques used for each project, definitional problems related to "recreational" and other types of fishing, where evident, some general findings, conclusions, and implications of the research as reported by the authors. Hence, the piece is not a critical review of the materials *per se*, but rather a set of summaries focusing on topics relevant to the informational needs of the emerging Task Force.

The materials are reviewed in alphabetical order by author for easy referencing. In some cases, authors cite pertinent materials not reviewed here; these are parenthetically referenced in the text. Some of the materials reviewed here are now dated, and specific findings in demographic numbers, economic dollars, and social and cultural processes must be considered in the temporal context in which they were written. Providing that context is beyond the scope of this review. Nevertheless, even the most dated materials provide some important information about research and sampling methods, analysis, and the problematics of the topic at hand, as manifest at the time of writing. Taken together, the following summary reviews are intended to provide an historically accountable picture of efforts taken thus far to further understanding of the non-commercial components of fisheries in the Western and Central Pacific.

This report was funded as part of cooperative agreement #NA67RJ0154 between the Joint Institute for Marine and Atmospheric Research (JIMAR) and the National Oceanic & Atmospheric Administration (NOAA). This study is part of the Hawaii Fleet Industry & Vessel Economics project, part of the University of Hawaii's Pelagic Fisheries Research Program. The views of the papers summarized in this annotated bibliography are those of the author and do no necessarily reflect the views of NOAA or any of its subdivisions.

Acknowledgments

A number of persons provided assistance in developing this review. They deserve acknowledgment and appreciation: Sam Pooley, Bert Kikkawa, Dave Hamm, and Sandra Abbott-Stout of the National Marine Fisheries Service, Honolulu Laboratory; Marcia Hamilton of the National Marine Fisheries Service, Pacific Islands Area Office; and Walter Ikehara of the State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources.

Acronyms

ASA	American Sportfishing Association
CNMR	CNMI's Division of Fish and Wildlife
CPUE	Catch per unit effort
CNMI	Commonwealth of the Northern Mariana Islands
DAR	State of Hawaii, Division of Aquatic Resources
DAWR	Guam's Division of Aquatic and Wildlife Resources
DLNR	State of Hawaii, Department of Land and Natural Resources
DMWR	American Samoa's Department of Marine and Wildlife Resources
DOCARE	State of Hawaii, Division of Conservation and Resource Enforcement
DOT	State of Hawaii, Department of Transportation
FDCS	Fishery Data Collection System
FMAs	Fishery Management Areas
FMP	Fishery Management Plan
JIMAR	Joint Institute for Marine and Atmospheric Research
MFCMA	Magnuson Fishery Conservation and Management Act of 1976
MHI	Main Hawaiian Islands
MRFSS	NMFS' Marine Recreational Fishery Statistics Survey
NMFS	National Marine Fisheries Service, NOAA, Department of Commerce
nmi	nautical mile
NOAA	National Oceanic and Atmospheric Administration
ORI	Omnitrack Research & Marketing Group, Inc.
PIAO	NMFS' Pacific Islands Area Office
RIMS II	Bureau of Economic Analysis Regional Input-Output Modeling System
USACE	United States Army Corps of Engineers
WESPAC	Western Pacific Regional Fishery Management Council
WTP	willingness-to-pay

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Adams, Michael F.

1978 Alternative estimates of net economic benefits for billfish-tuna recreational-commercial fishermen in Kailua-Kona, Hawaii. Southwest Fisheries Center Administrative Report H-78-18.

In response to initial passage of the Fishery Conservation and Management Act in 1976, this paper addresses economic aspects of what the author terms Hawaii's "weekend trolling fleet," estimated at some 1,500 vessels (p. 1). Using unspecified data collection methods and a sample of 386 vessels in Kailua-Kona, Adams calculates net benefits for the weekend fleet by summing consumer surplus and net revenue. The author defines consumer surplus and net revenue for the recreational fisherman as

> . . . the difference between what the individual is willing to pay for different quantities of a good and what he actually pays . . Net revenue [meanwhile] is based the sale of fish and the cost of the fishing trips attributed to the fisherman's choice to make some commercial sales (p. 2).

Adams generates demand models where T_i is the number of passenger trips for the ith vessel during 1976, where P_i is the operating cost per passenger trip for the ith vessel, where V_i is the current value of the ith vessel and gear, where C_i is kilograms of fish caught per passenger trip for the ith vessel, where y_i is the annual income for the owner of the ith vessel, and where E_i is the "disturbance term." The author notes that leisure time is an important explanatory variable not specified in the models due to absence of data.

Model One, which considers all members of the fleet as "recreationalists," generates total net benefits of $1,637,412. Model Two, which divides the fleet into autonomous recreational and commercial units, yields total net benefits of only $267,505. Model Three considers the economic costs and benefits of "weekend" fishermen who sell fish but without dividing them into discrete groups, yielding total net benefits of $1,117,470.

In formulating Model Two, Adams recognizes (p. 6) that for fishermen who sell their catch, those selling 17 percent or less do not behave differently than those selling no fish at all. Persons selling more than 17 percent of total catch, however, appear to take more trips, a fact Adams asserts may be attributed to ability to sell that catch which is in excess of what is needed for home consumption or gifts. Thus, the author divides the fleet into individual recreational and commercial components, yielding a consumer surplus of $1,620 for each of 166 recreational vessels, and a negative total net revenue of -$1,415 per each remaining commercial vessel. Under the parameters of this model, the combined net benefits for the recreation and commercial components of the fleet total only $267,505.

In formulating Model Three, Adams notes that the recreational fisherman will keep fishing until the marginal value is equal to the price of fishing, and the fishermen will take additional trips only when benefits beyond existing recreational benefits are perceived as attainable. Thus, the fact that fishermen can sell part of their catch in Kailua-Kona prompts many to take additional trips (with inherent costs, p. 8). Adams notes that while motivations to sell include the price of fish at market, the net revenue received for additional trips yields considerable net benefits to the fleet.

CIC Research, Inc.

1983 Fishery data collection system: Saipan. Southwest Fisheries Science Center Administrative Report H-83-20C.

This contract report recommends modifications to the then fledgling fisheries data collection system used by the Division of Fish and Wildlife, Commonwealth of the Northern Mariana Islands. Specific survey and sampling techniques and expansion algorithms are recommended. While the small size of the island, commercial fleet (then 150 small vessels), and market (40 businesses buying locally caught products) enable "certain data collection procedures not normally feasible" (p. 6), CIC reports (p. 1) that increasing rates of tourism activity coupled with part-time commercial vessel activity (68.8 percent of vessels), full-time commercial activity (23.4 percent), recreational fishing activity (7.1 percent), and an unspecified level of subsistence fishing activity, were elevating pressures on the area's resource base, requiring comprehensive compilation and assessment of relevant data. CIC responds to a stated high likelihood that the fishery will expand over time, providing detailed insight on how to best modify the then current census system to accommodate that change, with due attention to precision and accuracy.

CIC reviews (pp. 19-26) critical design components for a successful Fishery Data Collection System (FDCS). These include (1) areal fishing experience considered in its human, spatial, and temporal terms; (2) surveying factors addressing issues of cost, key variables, and error margins; (3) sampling design including statistical and qualitative inference methods, and survey implementation; (4) development and operation of the system database; (5) operation of expansion algorithms with assessment of their reliability; (6) quality assessment methods including both internal and external components; and (7) a presentation strategy. The FDCS components are then used to address the unique attributes of the situation in Saipan.

Among the most important considerations in applying the FDCS to the Saipan case is the sampling strategy. CIC recommends (p. 41) a triangulated effort with face-to-face interviews focusing on the inshore fishery, a voluntary logbook census focusing on catch and effort for the offshore fishery, and observation of participation in both fisheries. Sample size for the inshore interviews would be derived from classical sample size determination formulas and would be applied to four distinct geographical regions across the island. If the logbook effort for the offshore fishery were to fail, a survey method would be implemented. Surveys would be modeled after the roving creel survey of Malvestuto and Davies ("An Evaluation of the Roving Creel Survey with Non-uniform Probability Sampling," Transcript American Fishery Society, 107 (2):255-26, 1979) wherein the sampling strategy "generates an unbiased sampling and estimation of fishing success, defined as the weight of fish caught per [intercepted] fisherman per fisherman hour or catch per unit effort

(CPUE), in this case stratified by island region and across temporal units (p. 52). CIC warns of the potential difficulty in intercepting and gaining quick rapport with fishermen. Surveys potentially implemented for both fisheries would ideally also be complemented with a qualitative component to assess night and illegal fishing.

Cooper, James C. and Michael F. Adams

1978 Preliminary estimates of catch, sales, and revenue of game fish for the fishery conservation zone around and between the Main Hawaiian islands, by types of troll and longline vessels and by species, 1976. Southwest Fisheries Center Administrative Report H-78-24.

Cooper and Adams note that this report "presents the best available data to satisfy specific requirements of the Pacific Billfish Fishery Management Plan until statewide surveys can be completed for Hawaii" (cover page). The first section of the report estimates number of vessels active in each of the following Hawaii fisheries: (1) charter fishing, (2) non-charter recreational-commercial, (3) full-time commercial trolling, (4) domestic longlining, and (5) foreign longlining.

The authors estimate number of vessels per category using a variety of data sources. These include State of Hawaii, Division of Fish and Game statistics; Department of Transportation (DOT), Harbors Division statistics; a 1973 report by Information Concepts that included an assessment of Hawaiian vessels; and a 1977 study of Billfish prepared for NMFS by Research Associates, Inc.

Of interest, the report notes that Harbors Division lists only 1,186 of the then total 16,947 undocumented fishing vessels in Hawaii as fishing vessels. Of these, 117 are listed as charter vessels and 1,069 as non-charter. Information Concepts, Inc. lists 2,986 unspecified fishing vessels, while Hawaii's Division of Fish and Game counts 1,437 unspecified fishing vessels.

The work of Research Associates (entitled "A Study of Bioeconomics and Optimal Management Criteria for Utilization of Pacific Billfish, Module I," prepared for NMFS, Honolulu Laboratory, 1977, 139 pp.), extrapolates from a survey-generated count of 426 Kailua-registered troll vessels that includes 386 non-charter "recreational-commercial" troll vessels and 40 commercial troll vessels, to assert a total of 730 and 1,704 troll vessels for the Big Island and the state, respectively. The term "recreational-commercial" denotes vessels whose captains fish with recreational motives but who sell part of the catch to cover expenses. While Cooper and Adams champion these findings which include catch, sales, and revenue extrapolations for each category of charter, private recreational-commercial, and private commercial vessels in Kailua-Kona for 1976, an account of the study's research design is not provided.

Everson, Alan

1994 Fishery data collection system for fishery utilization study of Kaneohe Bay two-year interim report. State of Hawaii Division of Aquatic Resources Technical Report 94-01. Honolulu.

Everson reports on a project funded by the State of Hawaii Department of Land and Natural Resources (DLNR) to estimate total catch and effort at Kaneohe Bay, Oahu by means of a creel survey. The study, conducted from December 1990 through May 1992, also sought to chronicle perceptions about fishing in Kaneohe Bay from local experts. Data were collected bi-weekly on alternate weeks, and expanded catch and effort estimates were generated for all major fishing methods.

A combination of roving creel/vantage point and access point surveys were used in the field. The *roving creel* survey was implemented primarily in daylight hours wherein the researcher would traverse, by automobile, a predetermined route along the Kaneohe Bay shoreline to assess rates and kinds of participation, including both shoreline and boat fishing. Given problems of access, a high-powered spotting scope served to aid observation. Data collected during this part of the effort included number of boats and fishers by sector; kind of activity per vessel or fisher; type of fishing and number of gear; number of non-fishing vessels; and weather and sea conditions. Fishing activity was also considered in terms of its active or passive attributes and participants enumerated as such; certain net users, for instance, were enumerated only once per day (pp. 4-5).

The *access point* survey required that researchers intercept vessels returning from fishing trips to record the area fished, gear used and total time of use, catch (pieces and weight), and perceptions about general problems in the fishery. Since Heeia Kea is the primary access point in Kaneohe Bay, researchers conducted the intercepts from this location (pp 5-6).

Total catch and effort estimates were generated using basic data expansion technique used by Malvestuto et al. (S.P. Malvestuto, W.D. Davies, and W.L. Shelton, 1978, An evaluation of the roving creel survey with nonuniform probability sampling, *Transactions of the American Fisheries Society*, 107:255-262). Results are enumerated for six quarters, winter 1990 through spring 1992, while annual catch and effort statistics are presented for 1991-1992. The author ranked frequency of gear usage in Kaneohe by type per survey results noting the following outcome, most frequently used followed by successively less frequently used (1) pole and line, (2) spear, (3) troll, (4) crab net, (5) cast net, (6) invertebrate collecting (for aquarium), (7) limu harvesting, (8) dip net for bait, (9) fence net for shrimp and small fish, (10) aquarium dip net, (11) trapping for fish, lobster and crab, (12) gillnet, and (13) surround net. Data analysis per gear use also includes total effort in hours per weekday and weekend, and CPUE by subregion, by season, and annually.

Of concern to gillnet interests, 1,160 gillnet effort days were observed in 1991, with most effort occurring in the fall (438), and the least in winter (146). Gillnetting accounted for the greatest percentage of harvest among all observed methods, with over 40,000 pounds taken during the period 1991-1992 (p. 27). The author notes (p. 36) that "a few full-time commercial netters fish in Kaneohe Bay, but most net fishers have another full-time job and supplement this income by selling all or part of the catch." By way of contrast, pole and line anglers had the lowest CPUE of all methods, and under one percent of these persons reported selling any catch (p. 35).

With respect to pelagic-related activity, the author reports (p. 21) that most of Oahu's aku boats seek (anchovy or *Encrasicholina purpurea*) for bait in Kaneohe Bay, with an estimated 768 hours applied to the effort annually. Some 58 percent of trolling was observed in the central section of the Bay, usually adjacent to the barrier reef and scattered reef patches. Most boat fishing occurred on weekends and holidays (p. 21). Troll fishing accounted for a relatively small percentage of the overall take of fish in Kaneohe Bay; only trap fishing accounted for less. Approximately 3,000 pounds were taken by troll methods during 1991-1992 (p. 27).

Harvest was also analyzed by species (pp. 28-33). Tako (octopus) accounted for the vast percentage of take, at 44.7 percent. Most tako was taken by spear (p. 36). Goatfish followed at 8.6 percent,

followed by crabs at 7.8 percent, and jacks at 7.8 percent. Other species taken include, by order of estimated percentage: akule, taape, awa'awa, awa, uhu, various sharks, oio, barracudas, wrasse (hinalea), humu, palani, and kala. Miscellaneous other fish, fish-like species and crustaceans account for the remainder. Species takes varied by season, though tako remained most frequently harvested throughout (p. 29).

Interviews with fishermen in the Kaneohe Bay area suggest that resource abundance in the bay is diminishing. Although explanations for why this is perceived to be the case are highly variable, Everson notes (p. 35) that urbanization and pollution are seen as the major causes for the decline. In some cases, however, internal pressures are cited for the reduction of some species. Some local fishermen assert that nehu and other species are declining as a result of bycatch pressure from aku boats. The authors note, however, that these arguments are largely unsubstantiated, and that the size of the fleet and amount of pressure suggest other factors are at work, though "evaluation of nehu netting on the bay was one of the recommendations of the Kaneohe Bay Task Force, which in 1992 developed a comprehensive plan for protection, maintenance and sharing of the bay's natural, cultural and aesthetic resources" (p. 38; Office of State Planning, 1992, Kaneohe Bay Master Plan, Honolulu).

The author suggests that more and better data about the status of Hawaii's near and offshore fisheries is essential for sound management in the future. Everson also indicate problems potentially involved in instituting changes in he deems as a currently relaxed regulatory climate, noting that the public perceives regulations and imposition of licenses as an "infringement on rights to use the resource" (p. 38). They also mention a need to enumerate the total sportfishing population, and assert that "identifying specific areas and species of concern through fishing survey could be the first step in establishing effective management criteria" (p. 38).

Hamilton, Marcia S.
1998 A system for classifying small boat fishermen in Hawaii. *Marine Resources Economics*, Volume 13, pp. 289-291.

This paper discusses findings from a statewide economic survey of small vessel fishing operators (reviewed later in this document) to clarify the term "commercial" as it applies to small vessel marine fishing in Hawaii. The author reviews this definitional problem for Hawaii's fishery managers, noting (p. 289) that, according to state law, "any fisherman who sells at least one fish in a year is considered a commercial fisherman and must obtain a commercial marine license for that year," but that fishermen and other industry members "generally consider a commercial fisherman to be one who depends on profits derived from fishing for at least a portion of his income," and that "this would exclude a large number of Hawaii's fishermen who sell fish in an attempt to cover their fishing costs but never realize, or expect to realize, an economic profit from their operations" (p. 289).

Hamilton used a series of screening questions to ultimately classify fishermen as (1) "recreational," defined as persons who claim not having sold fish over the previous 12 months, (2) "expense," defined as persons who reported selling fish only to cover the cost of their fishing trips, (3) "part-

time" commercial, defined as persons reporting 50 percent or less of personal income derived from fishing, and (4) "full-time" commercial, defined as persons putatively earning more than 50 percent of income from fishing. Analysis of variance across a subsample of 382 pelagic fishermen was then conducted to determine the validity of the categories. Eleven variables were considered in the analysis: number of fishing trips taken annually, total annual catch, catch per trip, percent of annual catch sold, annual gross fishing revenue, percent of income from fishing profits, total investment, annual fixed costs, average price per pound received, annual household income, and operator's age.

The author notes that statistically significant differences ($p<.05$) were found between each of the four groups for the following variables: (1) number of trips, (2) total catch, (3) catch per trip, (4) percent sold, (5) gross fishing-related revenue, and (6) percent of income from fishing profits. Total investment and annual fixed costs were not significantly different for part-time and full-time commercial respondents, and prices received for all respondents selling fish were also comparable, suggesting similar "access to fish of similar quality and to similar markets."

Thus, Hamilton asserts (p. 291) that the classification system is useful, that "screening criteria were meaningful to survey participants, and analysis of the data collected indicates that there were many significant differences between groups." The author further argues that the results "provide a structure and a baseline for assessing the potential and actual impacts of any new regulations," and that these "may help us to devise more effective fishery management systems" (p. 291).

Hamilton, Marcia S.
1998 Cost-earnings study of Hawaii's charter fishing industry, 1996-97. SOEST 98-08. University of Hawaii.

This report addresses selected operational and economic aspects of Hawaii's charter fishing fleet through analysis of variables related to vessel operation and characteristics, demographics, investment and gross revenue, fixed costs, trip costs, and catch. The initial sampling frame was derived from the State of Hawaii Division of Aquatic Resource (HDAR) commercial marine license database which includes a charter fishing variable on its application questionnaire. While 265 licensed charter operators were listed in 1996, incomplete records, duplications and trailered vessels reduced the frame of active boats to 160. Direct observation at the harbors during the course of the study, however, yielded a count of 199 active boats. Thus, captains and/or owners from 62 of the state's 199 active six-passenger boats were interviewed during 1997. The survey addressed charter activities occurring during the previous year at the major small vessel ports of Honokohau on Hawaii, Lahaina and Maalaea on Maui, Kewalo on Oahu, Port Allen and Nawiliwili on Kauai, and Kaunakakai on Molokai.

Summarizing an array of survey findings, Hamilton reports (p. 96) that when averaged across the existing fleet of 18 vessels, Lahaina was the busiest port for charters during 1996, with a per vessel average of 243 trips. Honokohau's fleet, while the largest in the state at 124 vessels, took the fewest trips on average at only 126. Honokohau also offered the least expensive trips on average at $524 for a full day exclusive charter, and $60 for a full day shared charter. Kauai-based vessels charged the highest rates on average at $725 for a full day exclusive charter and $168 for a shared full day

charter but operated with the lowest advertising expenditures at an average annual rate of $3,420. Kewalo-based vessels spent more than the rest of the fleet on average for advertising expenditures at $10,940 per annum, and at $563 for a full day exclusive charter and $117 per full day shared charter, averaged second only to Honokohau for cheapest rates. As regards catch, Kauai vessels were most successful at an average of 17,669 pounds per vessel annually, followed by Lahaina at 12,220 pounds, Kewalo at 8,723 pounds, Honokohau at 6,625 pounds, and Maalaea at 4,333 pounds.

Hamilton's analysis indicates (p. 96) that various factors underlay successful charter operations in Hawaii. These include close proximity and/or ease of access to the harbor by prospective patrons, the presence of sales booths at the harbor, numerous referrals from hotel or activity desks, active ownership, and limited competition, i.e., relatively few charter vessels per port. Lahaina meets all of these requirements, while Honokohau suffers in each category.

Hamilton, Marcia S., and Stephen W. Huffman
1997 Cost-earnings study of Hawaii's small boat fishery, 1995-96. University of Hawaii SOEST 97-06/JIMAR 97-314.

Hamilton and Huffman report on a survey of small vessel fishermen through which a variety of data were collected, including operator demographics, vessel operations and characteristics, investment and fixed costs, catch and effort, and sales and gross revenue. The survey did not seek to determine the magnitude of the small vessel fishery in terms of participation, landings, or revenue, but rather sought to "provide a picture of the costs and earnings associated with typical small pelagic fishing vessels as well as information on vessel operations and operator characteristics" (p. 3).

A total of 808 small boat fishermen were approached for survey, with 602 persons ultimately participating in person, and 23 agreeing to complete a mailback version. The effort yielded a total of 569 surveys completed in a manner sufficient for analysis. Pelagic and bottomfish fishermen were separated for analysis *post factum* the survey. Sampling involved stratification by four groups: full-time fishermen were defined as persons earning over 50 percent of income through fishing-derived profits, part-time fishermen were defined as earning less than 50 percent of income through fishing-derived profits, expense fishermen were defined as persons selling fish to cover trip costs, and recreational fishermen were defined as persons not selling fish for any reason during the past year. Surveys were conducted on each of the major islands including Lanai and Molokai, at each of the 21 major ramps and ports accommodating small vessels. The vast majority of captains surveyed trailered their boats to the harbor.

The authors report that 72 percent of respondents sold some of their catch during the previous year. Of these, nearly 40 percent reported that the fish were sold to cover trip expenses; the remainder were considered "income" fishermen, that is, full-time or part-time commercial fishermen. Nearly 28 percent of the sample reported not having sold fish during the last year; these persons were considered "recreational" fishermen. The authors address uncertainties in the term "recreational," noting at once the possibility that self-reporting opportunities may lead to prevarication about not selling fish, but also that this group was unique in terms of having higher household income, lower levels of fishing activity, and less success at catching fish. Given reportedly lower levels of fishing

activity, the authors posit that recreational fishermen as defined may be under-represented in the sample and that, of those sampled, levels of activity may be relatively higher than the entire group.

The report provides a wide array of descriptive statistics and cross-tabulations descriptive of the small vessel operation in Hawaii. Of potential note for definitional concerns, gross revenues and percentage of catch sold were reported as highest for full-time fishermen (91 percent sold), followed by part-timers (85 percent sold), and finally, expense fishermen (57 percent sold). Levels of investment and fixed costs also followed this pattern. Importantly, the expense fishermen typically operated at a significant loss. Average annual gross revenue was about $4,000 with annual fixed costs at about $3,700 and annual operating costs at about $9,500. Gear usage differed by island in relation to known underwater topographic features, and while the majority of fishermen reported having used more than one gear type over the past year, trolling was most popular across the groups, followed by bottomfish fishing, and finally, reef fishing.

Hamm, David C., Nathan T.S. Chan, and Michael M.C. Quach
1998 Fishery statistics of the Western Pacific, Volume XIII. Southwest Fisheries Science Center Administrative Report H-98-04.

This Western Pacific Fisheries Information Network (WPacFIN) report provides fisheries statistics and a brief discussion of methods used to gather and process the data for management jurisdictions in the central and western Pacific. This is the thirteenth in a series of annual reports generated through the WPacFIN Fisheries Data Coordinating Committee. Participating jurisdictions include NMFS, WESPAC, American Samoa's Department of Marine and Wildlife Resources (DMWR), the Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife (CNMR DFW), Guam's Division of Aquatic and Wildlife Resources (DAWR), and HDAR. The 1996 report contains summary commercial landings and creel survey landings data for American Samoa, and commercial landings for the Commonwealth of the Northern Mariana Islands, Guam, and Hawaii.

American Samoa, historically the domain of small troll and bottomfish vessels, is experiencing an increasing number of larger vessels in the newly developing longline fishery and a concomitant increase in catch of some pelagic species. DMWR has traditionally kept track of catch and effort by interviewing fishermen at the end of their trips as part of a commercial fishery monitoring system. Hamm notes, however, that this was labor-intensive and did not address recreational and subsistence trips. Thus, in 1985, a new creel sampling program was initiated on Tutuila to include all aspects of the offshore fishery. This involves systematic random sampling stratified by type of day (weekday or weekend-holiday); DWMR staff normally sample two weekdays and one weekend-holiday per week. Survey estimates are expanded to generate Tutuila-wide values. Data are collected on date, type of day, time, boat name, captain or owner's name, fishing method, disposition of catch, species and number of pieces, weight and price per pound per species, area fished, home island, number of trips since last interview, total trip weight in pounds, total hours fished, number of fishermen participating, and type and number of gear used. Expansion algorithms implemented in 1992 calculate the monthly mean CPUE for each fishing method (sum of catch divided by sum of the effort), using all interviews for the time period analyzed:

> The variance of the CPUE is estimated by using the standard, but more complex, formula for a ratio estimator. Sample day participation counts and percent coverage estimates are still used to estimate total effort, but the split of the effort between fishing methods and the mean CPUE for each method are now calculated using interviews collected during the entire time period, thus reducing the potential biases caused by the small number of interviews on any given sample day (Hamm, p. II.3).

American Samoa's offshore fishery data are reported by month, including species composition by gear; annual summary data are also provided. The longline fishery is most active and productive, followed by the troll fishery, then bottom, and finally, troll/bottom mix (p. II.46).

The fishery in the **Commonwealth of the Northern Mariana Islands (CNMI)** is dominated by small runabout type vessels, though the authors report (p. III.2) a growing charter fleet and a rapid increase in the number of commercial vessels. Trolling is most common, but bottom and reef fishing are also important. Subsistence fishing is popular. Commercial activities yield fish sold locally and exported to Guam, Hawaii and Japan. In 1983, vessels from various nations began using the port at Tinian to facilitate transhipment of tuna; this continues today.

The CNMI DFW uses a dealer invoicing system on Saipan to collect commercial fisheries data. Invoices are provided to all purchasers of fish products including hotels, stores, restaurants, markets, and roadside vendors. These are completed each time fish are purchased; one copy is kept and the other returned to DFW. The system has advantages in that it is relatively labor-forgiving and provides relatively comprehensive coverage of fish that is sold. Its disadvantages include the need to educate all buyers about the process, omission in enumeration of fish landed but not sold, and problems with accurate species identification. DFW estimates the survey has captured 90 percent of fish landed commercially in Saipan since 1983. Data include date, buyer's name (dealer), seller's name (fisherman), species or family names, weight, price per pound, value, and invoice number.

A creel survey was implemented in 1982 to aid in estimating non-commercial elements of the CNMI catch but these data are not reflected in the report. Monthly, and some yearly data summaries are provided for a range of pelagic, reef, and bottom species for poundage, total value, and price per pound. The report also summarizes monthly averages for these variables for the period 1979-1996.

The authors describe two basic kinds of fishing for **Guam:** offshore and inshore; the former involving small vessels from 12 to 48 feet that take one to two day troll or bottom trips originating from the western and southern harbors. Charter fishing is reported to be a growing enterprise. Inshore fishing typically involves casting, netting and spearfishing without a boat. Guam's DAWR reportedly has been conducting inshore and offshore creel surveys since the early 70s (p. IV.1) though the particulars of this process are not discussed in the report. Sampling methods were improved in 1982 through the efforts of WPacFIN, and computers were introduced to assist data processing and analysis. A revamped computer system and analyses were in progress at the time of the 1996 report writing and so the statistics provided in Hamm et al. reflect the now outdated system.

WPacFIN also initiated a cooperative dealer invoicing program with Guam Fisherman's Cooperative in 1982 to track commercial landings. This voluntary reporting system has been used with various dealers besides the co-op and the effort continues today. Because no license is required to sell fish in Guam and because reporting is voluntary, the database is not fully reflective of total commercial activity. Data collected with the invoice system include date, fisherman, number of fishermen, hours fished, area fished, species, number of pieces, pounds, and price per pound.

Hamm et al. report that in 1996 some 4,200 commercial fishermen submitted the standard C-3 monthly reports to **Hawaii** DAR, and that nearly 76 percent of Hawaii's commercial catch was landed on Oahu. About 17 percent was landed on Hawaii, four percent on Kauai, and three percent on Maui. The authors also report that about 90 percent of Hawaii's 18,000 vessels are pleasure boats, with five percent commercial or charter fishing boats, and the remainder non-fishing commercial vessels. The pleasure category is said (p. V.1) to include "boats used for recreational, subsistence, and part-time commercial fishing as well as boats not typically used for fishing such as sailboats."

DAR has been collecting statistics of Hawaii's fisheries for the last 50 years (p. V.1). The 1996 summary data for commercial landings provided in the report are believed to represent about 99 percent of what will eventually be processed (ibid.). The Standard C-3 reporting form includes the following variables: name and license number, boat name and registration number, date, area or buoy fished, species caught, number of pieces caught, pounds caught, pounds sold, value of sales, and port of landing. There are also fishery-specific reporting forms that require more specific information. While the self-reporting system has the advantages of low cost, comprehensive coverage and efficiency, it requires active and committed cooperation on the part of the fisherman to achieve accuracy and completeness. The authors note (p. V.2) that the degree of accurate coverage achieved by the reporting system ranges widely between species but probably averages about 80 percent across the fisheries. The report does not address the lack of a data collection system for non-commercial landings.

Hamm, David C., and Henry K. Lum
1992 Preliminary results of the Hawaii small-boat fisheries survey. Southwest Fisheries Science Center Administrative Report H-92-08.

Hamm and Lum report on analysis of a 1990-1991 small vessel catch and effort survey conducted at eight public launching facilities on Oahu (Pokai Bay, Heeia Kea, Keehi Lagoon, Hawaii Kai, Haleiwa, Ala Wai, Lanikai, and Kahana Bay). HDAR coordinated a subcontractor during the data collection phase of the project which involved counting vessels from before sunrise to after sunset, and interviewing captains as possible to determine catch, effort and species composition. NMFS and WPacFIN conducted data verification, quality control, data processing, analysis and summarization. A consulting firm was used to ensure the statistical validity of expansion algorithms for survey-derived estimates of island-wide catch and effort. The sample design included both "commercial" and "recreational" small boats trailered to or moored at the facilities, and was stratified by (1) port (four "major" and four "minor" ports around the island), (2) day

(weekend/holiday versus weekday), and (3) fishing method. Surveys were conducted four to five days per month during a total of five three-month periods.

An estimated 78,261 trips were taken during the period March 1990 to February 1991 (p. 8). Trolling was reportedly the most frequent method used, accounting for 53 percent of the estimated trips, followed by bottomfishing at 12 percent, spearfishing at 11 percent, and spin casting at 8 percent. Trolling also accounts for 55 percent of the total annual catch by weight; bottomfishing accounts for about nine percent, and various netting methods account for 19 percent. Pokai Bay (Waianae) was the most popular port from which to fish, accounting for 37 percent of the trips. It was also the most frequent place of landing, with 38 percent of the total catch. Heeia Kea accounted for about 18 percent of trips and over 20 percent of landed catch. Keehi ranked third, with 12.3 percent of trips and 11.8 percent of catch. Pelagics constituted 55 percent of the total 75,000 pounds of sampled catch, followed by opelu and akule (18 percent), reef species (15 percent), and bottomfish (under six percent). Aku was caught most frequently, followed by mahimahi, goatfish, papio, akule, octopus, and yellowfin tuna. In terms of pounds of pelagic species landed, mahimahi ranked first with 11,706 sample pounds, yellowfin tuna second with 8,905 sampled pounds, aku third with 7,569 pounds, and blue marlin fourth with 7,342 pounds.

The authors express surprise that only 41 percent of catch was destined for sale and assert that it is undoubtedly a conservative figure, resulting from considerable non-response and prevarication to sales-related questions (p. 6). With respect to methods, netting and traps had the highest proportions of sales. Commercial fishermen are reported (p. 7) as having caught over three times as many fish per successful trip as the "purely recreational" fishermen. Commercial trips reportedly lasted an average of 8.5 hours, while "recreational" trips lasted six hours. Of interest to distribution of commercial activity and/or catch reporting issues, Hamm and Lum note (p. 6) that "although Pokai Bay had nearly twice the total estimated catch as Heeia Kea, it had only a slightly larger commercial catch."

Hida, Thomas S., and Robert A. Skillman
1983 A note on the commercial fisheries of Hawaii. Southwest Fisheries Center Administrative Report H-82-20 (revised).

While the authors provide no explicit discussion of recreational or other non-commercial types of fishing, this piece elucidates history regarding level of participation, landings, and ex-vessel value for pelagic and other species from the 1940s through 1982. Noting historic fluctuations in the commercial fleet, the authors state (pp. 1-2) that there were approximately 3,532 licensed commercial fishermen in 1947, but only 715 by 1960, regaining to 2,500 at the time of writing. Further, in 1970, 80 or more commercial vessels over five tons and fewer than 700 smaller commercial vessels plied Hawaiian waters, regaining to 130 commercial vessels over five tons and more than 1,000 small commercial boats by 1980. Hida and Skillman note (p. 3) that the Post World War II ika-shibi fleet of three or four boats slowly grew to about 30 boats by 1976 with an estimated 250 boats and 500 fishermen by 1983. Meanwhile, the commercial troll fleet had about 200 active vessels and 240 fishermen during 1981-82, many of whom mixed gear types during the course of the year.

Hoffman, Robert G., and Hiroshi Yamauchi

1972 Recreational fishing—its impact on state and local economies. Departmental Paper 3. College of Tropical Agriculture, Hawaii Agricultural Experiment Station, University of Hawaii. Honolulu.

This report describes an effort to examine socioeconomic aspects of recreational fishing in Hawaii as manifest in the 60s and early 70s. The authors preface their work with some history about impetus for such analysis, noting that "lack of data prompted the Hawaii State Division of Fish and Game to conduct inshore surveys of recreational fishing activities during the period between July 1958 and June 1961" (Hoffman and Yamauchi 1972:5 cite Hawaii Division of Fish and Game, 1960, Survey of Fishermen and Creel Census, Project Report Number F-5-R-7). That research involved use of spotting aircraft and boats to count shoreline and offshore anglers and determine type of fishing and gear used in each quarter of the year. The work generated an estimate of 550,000 offshore sportfishing trips taken annually, and an approximate average of 9,000 persons per week engaged in shoreline fishing—32 percent on Sundays and 28 percent on Saturdays, the remainder distributed relatively uniformly throughout the remainder of the week. This enumeration effort was eventually abandoned due to a "serious shortage of manpower" (p. 6).

In 1966, the State Division of Fish and Game reportedly (p. 6) began monitoring the activities of shoreline and boat fishing clubs and designed a system wherein club members would complete log book-like surveys, thus allowing variation of fishing efforts and success between locations per island, and across islands and seasons. That system, however, was never tried since "unforeseen circumstances [not explicated here] altered the course of action." A Marine Resources Advisory Panel, formed in 1967 as part of the Governor's Advisory Committee on Science and Technology "to assess the economic potential of the marine resources of the state," subsequently sought to develop a data collection system for recreational fishing that would putatively (p. 6) enable economic analysis comparable to that used for commercial fisheries at the time:

> Information such as number, age . . of sport fishermen and the expenditures they make . . . is not only desirable but essential for planning purposes. The findings of the survey will determine to a great extent how much emphasis to place on the development and management of our marine sport fishery resource and what alternative approaches to pursue in order to achieve our resource development and management objectives (Governors's Advisory Committee, Science and Technology, First Report of the Marine Resources Advisory Panel, State of Hawaii, 1967).

This position led to a Senate Resolution during the Fourth Legislation Budget Session of 1968 that the Division of Fish and Game "determine what economic studies would be required for evaluating the sport potential of the state" (pp. 6-7). Resolution proceedings noted that

> Whereas population growth and the explosion [sic] growth of tourism in the next few years will put even greater pressures on the recreational resources of the state, including ocean and freshwater

> game fishing; and, whereas planning for the best utilization of sport fishing resources requires estimates of their contribution to the economy of the state, that a study on recreational fishing in Hawaii not only be found most useful, but also of necessity" (ibid.)

In 1968, the University of Hawaii signed a Memorandum of Agreement with DLNR to conduct research for the purpose of estimating (1) participation in Hawaii's recreational fisheries, (2) the expenditures of recreational fishermen, and (3) the economic impact of recreational fishing in Hawaii. Hoffman and Yamauchi undertook the study and subsequently conducted a telephone survey on Oahu and an in-person household survey on the Neighbor Islands to generate the data and analyses. The sampling frame for Oahu was a mix of military and civilian households totaling 143,143 households, adjusted for households with no or unlisted phones, and ultimately represented 78 percent of the 1968 total of 171,329 Oahu households (the total population at the time was 633,200 persons per figures from the state Department of Planning and Economic Development, 1968). The target sample size was 6400 households. Meanwhile, a sample size of 1,600 households was derived from an unstated overall frame for the Neighbor Islands. This was partitioned into 107 clusters of 15 dwelling units each and stratified by enumeration district per island in proportion to the 1970 Census count. The sample was further proportionately stratified by finer geo-demographic distinctions the authors terms "measures," and "segments." In the end, dwelling units were identified for 110 segments across the islands and selected randomly for sampling from 1970 census and geologic survey maps" of unstated antiquity (p. 10).

Part A of the survey instrument was directed to both anglers and non-anglers and sought information regarding household size, outdoor recreational activity, and selected social and economic attributes of heads of households. Part B sought to determine recreational fishing expenditures, including those relating to equipment, food and other "on-site" items, transportation, vessel ownership, chartering, and club membership. This segment also queried about preferred fishing locations and estimated range of fishing activity. Part C sought information about all anglers in the family over 12 years of age, including types of fishing, number of days involved, age, ethnicity, education, occupation and income (p. 11).

The response rate for the Oahu survey, conducted over a year-long period between 1968 and 1969, was over 62 percent, with 30.6 percent fishing households and 69.4 percent non-fishing households responding. The Neighbor Island survey was conducted over a year-long period between 1970 and 1971. The response rate for Hawaii was over 73 percent, with 433 of 593 households responding, of which 43.4 percent were fishing households. The Maui County response rate was similar at 73.5 percent, with 411 of 559 Maui, Lanai and Molokai households responding, 53 percent of which were fishing households. Finally, the Kauai response rate was 73 percent, with 214 fishing households and 219 non-fishing households responding (p. 13).

The authors offer extensive, now dated, analysis of variables for which information was collected over the course of the study; readers are referred to the original document for more extensive review. Some summary findings and analytical comments are offered here. According to the report (p. 15), most "recreational" fishing at the time was conducted from the shoreline. This was true across the islands and for the state as a whole, where 68 percent of a total estimated 122,400 anglers fished

from beaches, rocks and cliffs. Just over twelve percent fished from boats, and about ten percent fished while diving (spear, Hawaiian sling, etc.). Most fishermen were male heads of household (50.9 percent across the state), followed by sons (20.2 percent), wives (16.1 percent), daughters (6.7 percent), and others (6.1 percent), with the high frequency age category being 12-18 years of age (pp. 16-17). All age groups between 12 and 53 years are relatively uniformly represented. Persons over 54 years comprise only 9.9 percent of the sample. The average number of days spent fishing per year across the state was 35.8. Most fishing costs were attributed to equipment purchases, followed by transportation costs, and trip-specific "living" costs such as food and beverages. On Oahu, Maile Point to Kaena Point was the most popular inshore fishing locale, with Diamond Head to Honolulu Airport the most popular offshore area. The area from Hoopuloa to Keahole Point was most popular for both inshore and offshore anglers on Hawaii Island. The most heavily used inshore and offshore areas in Maui County were from Puunoa Point, near Lahaina, to Makena Point, just south of Kihei. On Kauai, the most heavily used inshore and offshore fishing area extended from Moloaa Bay, north of Kapaa, to Kawelikoa, south of Lihue. The total economic impact of recreational fishing in Hawaii was estimated at around $11.5 million for the survey years 1968-1971.

Hoffman and Yamauchi's analysis of "recreational fishing" is of particular interest given the current effort to better define the nature of "recreational" and other forms of fishing in Hawaii, and indicates the history of definitional problematics. While the authors fail to differentiate between various non-licensed user groups in terms of ultimate economic disposition of landed fish, they did recognize the problem in 1972 (p. 36):

> This, then, leads to an important area of concern to the state. At the present time, there is wide consensus that, although many so-called "recreational" fishermen are not licensed to sell their catches in the fish markets, a substantial amount of these catches still find their way onto the local markets. The various dimensions that are involved in this gray area between "recreational" and "commercial" fishing were not addressed in this study and deserve further exploration.

Further complexity in definitional efforts is noted (pp. 36-37) as the authors recognize too, the fluidity of decision making across fisheries, gear types, and temporal parameters:

> Even within the recreational fishing sector as adopted for this study (i.e., all unlicensed fishermen), definitional aspects still remain. Not only is the total recreational fishing experience a complex bundle of fishing activities including the early planning and latter recalling phases of the actual act of fishing; but, also, additional complexities are introduced by the overlapping and joint nature of various types of fishing activities that are carried out in one or more areas during a fishing day (or trip) and throughout the year.

Among the study's findings was a reportedly (p. 37) common concern, especially among shoreline fishermen, that in a perceived context of too few fish in accessible spots, more productive spots were legally inaccessible as a result of land ownership by the military, large estates, resorts, and

plantations. Perhaps intuiting the struggles to come, the authors suggest that this situation "extends far beyond simply fishery resource management and involves more complex institutional issues of easements, regulations, compensation, etc., which is another and perhaps the most important area of concern for the public control of recreational fishing" (p. 37).

Finally, Hoffman and Yamauchi note (pp. 37-38) that recreational fishing is typically regulated in some fashion on the Mainland, but that apart from an abortive regulatory attempt in 1948 [not reviewed in the report], citizens of Hawaii have traditionally enjoyed unregulated recreational fishing as per Section 3, Article X of the state Constitution. Tradition notwithstanding, the authors suggest (p. 37) that "there is always the possibility of appropriating additional social benefits by a positive management program which is both efficient and equitable." The proposed form of such a program is vague however, although "increased monitoring" of "certain types of activities" is offered as one possibility. But the authors assert that the situation does (or did) not warrant a "comprehensive registration program for all recreational fishermen" (p. 37). Indeed, Hoffman and Yamauchi appear to resist the idea, noting that "participation in recreational fishing as a whole is distributed among fishermen in a skewed fashion toward the younger age groups and for older persons in the low income earning occupations, which suggests the strong possibility of a highly inequitable restriction of the total leisure time activities available in the state." Yet this statement is ultimately qualified (p. 38), and the report concludes with a call for more and better refined data, "which might be developed through more concentrated site and resource-oriented surveys," to aid in developing "selective registration and variable fee schedules which would be compatible with an efficient and equitable coastal fishery resource conservation program." Such efforts, the authors note, "are, without a doubt, called for and should be given the highest priorities and at the earliest possible time" (p. 38).

Human Sciences Research

1982 Marine recreational fisheries survey: catch and effort statistics. Final Data Collection Report: Three Year. Prepared for NMFS Resource Statistics Division, F/SRP, Washington, D.C.

Human Sciences Research (HSR) reports on data collection methodology and results for 1981, the third year of the catch and effort component of the Marine Recreational Fisheries Survey in Subregion 8, which includes the State of Hawaii, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI). HRS subcontracted Honolulu-based Survey and Marketing Services, Inc. for its data collection requirements. The work attends to recommendations from methodological studies conducted for NMFS that household surveys are insufficient for gathering the full spectrum of information about recreational fishing and should be complemented with an on-site intercept approach (e.g., Gary L. Brown, 1977, *A Review of the Literature in Selected Areas Relevant to the Conduct of Marine Recreational Fisheries Surveys*, McLean, Virginia: Human Sciences Research). HSR reviews its perspective on this approach (p. 3):

> . . the complemented surveys approach was developed in which data on the number of households with fishermen and the number of fishing trips during a two-month period was collected by a household

survey. Catch data, i.e., species, number, weight, length, etc., was collected by an on-site intercept survey. Data from these two separate sources were then combined to produce estimates of total catch and total participation.

The household portion of the 1981 data collection effort for **Hawaii** was conducted via a *randomized telephone survey*, with a sampling distribution reflecting distribution of the general population. Thus, 3,555 persons were interviewed on Oahu, 450 on Hawaii, 315 on Maui, and 180 on Kauai. Six waves of interviews reflected concern for observed seasonal variations in commercial catch across the islands. Meanwhile, a total of 11,000 *intercept surveys* were budgeted for Subregion 8 in 1981, with 7,500 allocated to Hawaii. The sample was stratified by "mode" of fishing, that is, by beach or bank, boat, or manmade structure (pier or jetty). The survey effort was allocated in four hour increments at sites "with a probability proportional to pressure data for each site," pressure data being an understanding of relative level of usage at the sites as determined by previous year's fieldwork. Reflective of concern for variability in fishing pressure, the authors note (p. 17) that "for the boat mode on all islands and for all modes on Oahu, 75 percent of all hours of interviewing effort were allocated to weekends," while for "the beach/bank and man-made structure on the Neighbor Islands, 50 percent of all hours were allocated to weekdays and 50 percent to weekends."

An *in-person household survey* was conducted in **Guam** with the assistance of Guam's Bureau of Labor Statistics (BLS). BLS has maps documenting all residential units on the island, and each was assigned a number. Sample households were then randomly selected from the base map and 1,337 intercept surveys were conducted in Guam. Because the survey team was denied access to residences on military bases, a randomized telephone survey was implemented with this sub-population (p. 10). The sampling strategy was based on extensive existing information about fishing sites. Occurrence of tides was the most significant sampling factor since most fishing on Guam is done at low tide (p. 17).

An *in-person* survey of 624 households was conducted in **American Samoa**. Clusters of six households were chosen randomly from a Department of Planning map depicting each of American Samoa's 76 villages. The number of clusters sampled from each village was determined by its population size. The sampling strategy for the *intercept survey* conducted in Samoa was based on recommendations of local fishing experts to adjust samples based on the size of villages adjacent to fishing areas. This reflected local fishing behavior wherein villagers rarely fished "further than the beach or bank immediately adjacent to their village" (p. 17).

An *in-person* strategy was also used to conduct a household survey in the **CNMI**, operationally defined here as Saipan, Rota, and Tinian. Households were randomly selected from a sample frame of all structures extant in 46 subareas in the region as depicted on a set of maps from the CNMI Planning Division of the Department of Public Works. Clusters of six dwelling units were selected from the frame, with number of clusters selected depending on population density per subarea. A total of 490 households were surveyed. The sample size for each island component of the CNMI *intercept survey* of 875 persons was proportional to the population of each island. Sample quotas by fishing mode were reflective of relative dedication of effort to each as determined by fieldwork during previous seasons. Thus, the authors note (p. 17) that "Beach/bank interviews were raised

from 50 to 58 percent of the total of Saipan, Rota and Tinian," while "boat interview allocations were reduced to 25 percent on Rota and Tinian but kept at 40 percent for Saipan," and "pier/jetty quotas were slightly more on the smaller islands than on Saipan."

The report describes the project sampling methodology and provides data collection instruments. Survey results are not included in the document and were not published but are archived at NMFS Honolulu Laboratory.

Kahiapo, John, and M. Kimberley Smith
1994 Shoreline creel survey of Hilo Bay Hawaii: 1985-1990. A report on research for the Main Hawaiian Islands Marine Resources Investigation. Division of Aquatic Resources, Department of Land and Natural Resources. Honolulu.

Kahiapo and Smith review a creel survey conducted to generate a better biologic understanding of recreational fishing activity in three ecologically distinct areas in Hilo Bay, Hawaii: the Hilo Harbor Fisheries Management Area, Waiakea Pond Public Fishing Area, and adjacent Keaukaha shoreline. A total of 4,285 anglers were interviewed during the five-year period from 1985 to 1990. The earliest phase of the survey was initiated following public concerns that the area was being overfished; this was completed in 1986 (p. 3). A second phase was conducted from 1987 to 1988 after gillnetting was banned in the Harbor area. The final phase lasted from 1989 to 1990. Because the survey was intensified during the last phase, those results are considered most representative of the Hilo Bay recreational fishery and are used to estimate species, size of fish and invertebrates, and CPUE. The report focuses on changes in these factors "before and after the closure of Hilo Harbor to gillnetting in June 1987" (p. 1).

Much was learned from initial phases of research of the predominately pole and line, scoop net, and throw net anglers (p. 6). For instance, access to various fishing areas was gained, rapport was developed with sometime reticent and secretive anglers, and data collection protocols were modified as appropriate. The second phase of research included more area, with more intensity of researcher involvement, encompassing early mornings, nights, and weekends and holidays. In all phases, personnel walked and/or drove the coast, approached as many anglers as possible for interviewing, and examined catch directly (p. 5). The authors also allude to education of cultural issues associated with fishing in the area (p. 5):

> Fishers were often interviewed individually. However, many groups of family and friends in the Hilo area fish together and throw all their catch into a single cooler or bucket. Furthermore, it is not the local custom to count or keep track of one's fish. The people of Hilo fish for enjoyment, to have something to eat or to share with their neighbors; not in the interest of competition. When groups which had thrown all their fish together were encountered and it was not possible to say who caught which fish, group interviews were conducted for up to 10 individuals on a single survey form.

Final phase findings are tabulated and include some limited angler demographics; mean hourly CPUE by gear type; relative abundance of principal species by location and survey period (scientific names only); mean total length of selected principal species (vernacular family names and scientific names); summary of seasonal trends in abundance and size (scientific names only); some species-specific size-frequency distributions (for palani, weke a'a, kumu, white ulua, aholehole, and 'omomee); mean fishing activity by survey area, day of week, and time period; and estimated annual weight of landings and mean gear abundance.

According to Kahiapo and Smith (p. 20), despite limited data in the earlier phases of research, results indicate that the size of fish landed in Hilo Harbor increased after passage of the amendment to restrict gillnets. Interestingly, this is concurrent with an increase in the number of anglers visiting from off-island. Hilo residents, however, remain the heaviest Bay users throughout all phases of research, followed by non-Hilo Hawaii Island residents. The authors estimate that annual landings for the recreational sector in Hilo Bay during the final phase of the survey were in the range of 31 to 121 short tons, extrapolated from 145 to 179 pounds of fish per day. Finally, as regards direction for future research, the authors note (p. 21) that despite inherent difficulties in interpretation of data collected across the survey phases, "these surveys define the principal gears and species used in a recreational manner and indicate that management measures that restrict gillnetting may indeed be helping to restore fish populations in the Hilo area."

Kasaoka, Laurel D.

1989 Summary of small boat economic surveys from American Samoa, Guam, and the Northern Mariana Islands. Southwest Fisheries Center Administrative Report H-89-4C.

Kasaoka provides brief summary analysis for a 1987 survey addressing active small vessel operators in American Samoa, Guam, and Saipan. Data were collected for five general categories of economic information, including (1) investment costs (value of vessel and gear); (2) annual or fixed costs, defined as financing charges, annual maintenance including major repairs, insurance and other business expenditures; (3) trip costs, subsuming daily operating costs in fuel, ice, food, and trip-related repairs; (4) crew costs, including salary and/or crew share of catch or profit; and (5) product costs, or fish marketing expenses involving handling, transportation, and commission. Fishermen were also asked to assess changes in these categories as they were perceived to occur over the previous five years and during the current year (1988). The sample size was 36 operators for American Samoa, 35 for Guam, and 34 for Saipan.

There is no explicit discussion of research design, nor of sampling rationale. The survey appears to have been conducted through a dockside convenience sample. Results are provided in basic descriptive statistical form, listing range, average, standard deviation and sample size for variables in each of the aforementioned information categories.

Maharaj, Vishwanie, and Janet E. Carpenter

1997 The 1996 economic impact of sport fishing in Hawaii. American Sportfishing Association. Funded by the U.S. Fish and Wildlife Service under Cooperative Grant Agreement No. 14-48-0009-1237 using Federal Aid in Sport Fish administrative funds. Alexandria, Virginia.

This American Sportfishing Association (ASA) report seeks to summarize economic activity related to the sport fishing industry in Hawaii. Results derive from data collected via the *1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreation* conducted by the U.S. Fish and Wildlife Service. That survey queries 28,000 U.S. "sportsmen" over 16 years of age about their "angling and purchasing behavior." Data are analyzed with the Bureau of Economic Analysis Regional Input-Output Modeling System (RIMS II) which "generates multipliers for estimating the direct, indirect and induced impacts of economic activity upon output, earnings, and employment" (p. 2). The authors report a five-step process template for generating economic impact analysis based on data collected from participants in each of the states, including Hawaii: (1) expenditures for sportfishing-related products and services are calculated and disaggregated by type of fishing, (2) estimated expenditures are disaggregated into retail wholesale and manufacturing portions, (3) economic multipliers are derived from the RIMS II model, (4) total economic impacts are estimated by combining multipliers with corresponding estimates for expenditures, and (5) tax revenues are estimated "using expenditure data and sales tax rates for state sales tax revenue, and earnings and jobs data with income tax rates for state and federal income tax revenue" (p.3).

The 1996 national survey was initiated with a nationwide telephone screening interview of 80,0000, followed by a four-wave detailed interview of persons likely to be anglers, hunters or wildlife-watching enthusiasts. In cases where respondents could not communicate by phone, an in-person strategy was used. The report does not indicate the sample size of Hawaii residents from which results were extrapolated.

Analysis of selected survey results indicate that 260,005 anglers fished in Hawaii during 1996, almost equally divided between residents and non-residents, and almost exclusively in saltwater. An estimated total of 2,301,744 saltwater trips were taken during that year. As regards expenditures, the authors assert that trip costs accounted for about 75 percent of all angler expenditures, with food, drink and transportation costs most prevalent (p. 4). Fishing equipment accounted for about 17 percent of expenditures, with rods, reels, and artificial lures accounting for most of the cost. Distribution of itemized costs, while tabulated, are not discussed in terms of resident status despite significant variation between residents and visitors. Residents, for instance, spend more on fixed costs associated with vessel and gear operation and maintenance, while visitor costs are more closely associated with transportation, lodging and other temporary expense categories.

A central purpose of the ASA report is to estimate and disseminate the positive economic impacts of sportfishing for each of the states. Thus, for the Hawaii case, the authors estimate that (1) $5,201,00 was collected from state tax on the sale of fishing related goods and services in 1996, (2) $3,961,280 accrued to the state coffer through state income tax related to wages and salaries, and (3) $7,472,000 accrued to the U.S. Treasury through federal income tax on wages and salaries related to sportfishing. Input-output analysis for 1996 also indicates saltwater angling expenditures total and estimated $124,477,713, offset by economic output of $228,272,316. The report also estimates

that sportfishing in Hawaii generates earnings of $70,46,235, and 2,948 jobs. Positive net benefits reportedly are up from 1991, but the authors caution against unqualified comparison since 1991 was a "period of economic recession, increasing gas prices and the Gulf War, while in 1996 the United States experienced a strong economy with low inflation and low unemployment" (p. 8).

Meyer Resources Inc. [Philip A. Meyer]
1987 A report on resident fishing in the Hawaiian islands. [a project to determine the economic value of recreational fishing in Hawaii]. Southwest Fisheries Center Administrative Report H-87-8C.

Meyer reports on a NOAA-funded project to determine the market and non-market economic value of recreational fishing in Hawaii. Other stated objectives include (1) identification of the satisfaction residents of the Hawaiian Islands associate with fishing, (2) identification of the variety of uses to which catch is put, (3) identification of [ocean] access points, (4) estimation of catch by species, (5) estimation of effort, (6) identification of attitudes and perceptions related to boating facilities, "and a range of other fish/boating issues in Hawaii (p. 1). From the outset the author makes clear the unique nature of the Hawaiian situation as regards blurred commercial and recreational distinctions:

> The term 'resident fisherman' refers to persons who are not making their primary living from commercial fishing. In other jurisdictions, such persons might be considered as recreational fishermen. In the Hawaiian Islands, however, any citizen may purchase a license for five dollars, enabling him/her to sell fish.
>
> This makes a sharp distinction between commercial and recreational fishing less meaningful. The resident fisherman, as defined here, will fish for enjoyment, own consumption, to obtain cash to defray boat expenses, and for a variety of other purposes, but not to obtain his or her primary source of income (Meyer, p. 1).

Meyer uses a combination of archival review and "key respondent" interviewing methods to pursue data collection objectives. The researcher met with presidents from 15 active boat clubs on the four main Hawaiian Islands to determine topics of interest from the perspective of clubs members, and to gain respondent's insight on topics of and the contractor. Results of the discussions were reviewed with NMFS, whereupon an outline was developed and used to direct subsequent focus group-style discussions with the boat clubs. Discussions related primarily to fishing during 1985. Finally, these data were analyzed and the results sent back to the clubs for review and verification of intra-club representativeness. While the author defends the utility of data collected in this manner for inter-club and inter-island comparison on selected variables, he notes (p. 6) that discussion of potential representativeness with respect to the boat fishing/shore fishing population in general must . . proceed inferentially."

Illustrative of the kind of information described by Meyers are total expenses per fishing trip per club across island. The costs are reported for 13 clubs for the four main islands, with a range from $85.39 for the Wailua Club to $187.28 for the Maalaea Club. The costs are then itemized and averaged by island with standard deviations noted. Oahu reveals the least expensive trip with a mean of $103.93,

while Maui the most expensive at $187.28. This strategy reveals some analytical utility but also the problematics of generalizing to other than club. For instance, since the Maalaea club was the only club extant on Maui in 1985, the reader cannot be sure whether the trip cost figures apply to only to the Maalaea area or whether they are applicable to Kahului, Lahaina, or to the Maui fishing population generally. Meyers alludes to this, noting (p. 11) that "results for the 9 at large fishermen we talked to on the Windward side of Oahu were lower, averaging out at $67 per trip," and that "We have no method of assessing what sub-group, if any, these results are representative of . ." Concerns for representativeness thus expand when Meyers combines data to calculate means for trip costs (and all other measured variables) statewide.

With respect to valuation of fishing, Meyer notes (p. 24) that since fishermen in Hawaii typically live close to ocean access points, willingness to travel to fish is not a good valuation proxy. Because the author asserts that the "willingness-to-pay" (WTP) concept tends to generate biased *under*estimates in Hawaii, and "willingness-to-sell" measures tend to generate biased *over*estimates, he recommends and tests (pp. 24-25) a "direct simulation of resident fishing values" based on "fair value estimates." In this case, this was accomplished by asking participants first the dollar amount they earn per hour at their jobs, then the amount per hour they would be willing to pay to fish (fair value).

"Fair value" valuation data were presented by island and for the state as a whole. Kauai club members claimed to make an average $13.08 per hour but were willing to pay only $7.30 per hour to fish. Maui club members made an average of $24.90 per hour and were willing to pay an average of $22.08. Big Island club members made an average $16.97 per hour but were willing to pay an average $23.00 per hour to fish. Finally, Oahu residents earned an average $22.22 per hour and were willing to pay $20.28 per hour to fish. Meyers then used multiple regression to test the possibility that certain factors would account for relative willingness to pay to fish. These included household income, fishing expenses, time on the water, fish caught, years of fishing, number of trip, and age of member. Interestingly, there were no statistically significant relationships between the response and independent variables, a fact Meyers asserts (p. 34) increases the external validity of the club survey results.

The author also conducted analyses to estimate non-market value lost due to a fifty percent reduction in catch per trip, estimated annual expenditures, disposition of catch, and a variety of other analyses with a wide array of variables. With respect to motivations to fish, the excitement of catching a fish was cited as most important when averaged across the islands. Principal motivations varied by island, however, and while the excitement of catching fish was most important for Oahu and Big Island club members, a chance to eat fresh fish was cited as most important on Maui and Kauai.

Miller, Marc

1996 Social aspects of Pacific pelagic fisheries, Phase I: the Hawaii troll and handline fisheries. University of Hawaii, SOEST 96-04, JIMAR Contribution 96-302.

Miller initiates a baseline sociocultural case study of Hawaii's troll and handline pelagic fishery, noting objectives for Phase I as (1) characterization of the fishery's institutional environment, (2) description of the social organization of the fishery, (3) identification of fishermen's perceptions

about management issues, and (4) development of a conceptual framework for "the continuation of cultural and social studies of the fishery" (p. v). The institutional environment is outlined through tabulation of the government entities that manage the troll/handline fishery, the databases developed and used by those entities, and the system of laws, codes and regulations through which management is effected. The social organization of the fishery is outlined through identification of its respective elements, that is, the harvesting element or fishermen; the aforementioned management element; the distribution element, which includes fish buyers and shippers; and the public element, including consumers and interest groups.

There is focus on the harvesting element, based on open-ended interviews with a convenience sample of 54 fishermen contacted at Kewalo Basin on Oahu, and Hilo and Honokohau on Hawaii Island. The author identifies aspects of the fishing way of life common to participants, including fishing motivations, the fishing trip, fish selling, fish sharing, and "fish talk," and he outlines a system for classification of fishermen that addresses styles of fishing: fishing for fun (termed "holoholo"), fishing for food (termed "kaukau"), expense fishing, profit fishing, and "combination fishing." Miller also reports fishermen's perspectives on select management-related issues, and cognitions about fish species. Management-related questions are presented, followed by participant responses and some frequencies of response; further analysis is not provided. The perceived relationship of fish species is depicted through multi-dimensional scaling; fishermen perceive the pelagics as belonging to one of three discrete categories: (1) billfish, (2) the tunas, or (3) ono/mahimahi. The report concludes with a tabulated series of recommended social science research priorities organized by FMP objective and the fishery's aforementioned organizational elements.

Omnitrack Research & Marketing Group, Inc.

1988 Sampling methodology for a boat fishing survey design for Hawaii. Prepared for Western Pacific Fishery Management Council, and National Marine Fisheries Service. Honolulu.

Omnitrack Research & Marketing Group, Inc. (ORI) attempted to (1) appraise then existing programs for estimating catch and effort in Hawaii, (2) review the methods and results of NMFS Marine Recreational Fishery Statistics Survey (MRFSS, 1979-1981), (3) design catch and effort data collection procedures for fisheries not covered by then existing programs, (4) pre-test a catch and effort survey design to determine "workability" in producing reliable annual estimates, and (5) determine the costs for "producing five, ten, and thirty percent coefficients of variation" (c.v.) for annual catch and effort estimates for selected species.

Based on analysis of existing statistics and studies, ORI determined that the fishing "trip" was a more efficient proxy for measuring CPUE than "number of active fishermen" (p. 9-1), and that estimating CPUE with a 20 percent c.v. would require sampling trips from all ports, for all quarters, and for all weekdays and weekends" (p. 9-1). Thus, in order to estimate number of trips per port per day on Oahu, for instance, seven out of ten ports would need to be sampled for 33 out of 40 days, for a c.v. of ten, and four ports out of ten for six days out of 40 for a c.v. of 30.

The logic of port sampling drives ORI's recommendations for an intercept survey to generate estimates of annual number of landings and CPUE by major port for major species per island. The

research design recommends a year-long period of interviewer intercepts in mornings and afternoons with small and medium-sized vessels (specified as under 20 feet and 21 to 40 feet, respectively), and a proportionately higher frequency of intercepts on weekends than on weekdays (one in two vessels on weekends). The design suggests sampling 49 weekdays and 59 weekend days per year at between one and eight strata per island or county, the number ultimately depending on costs and concerns for analytical accuracy. Selection of sampling strata would be determined through consideration of "a probability proportional to number of landings during most recent year" (p. 3-3). Larger ports such as Lahaina are considered "self-representing" individual stratum, while smaller ports (such as Mala Wharf and Paia) or islands (such as Molokai and Lanai) would be combined to form a stratum. Strata could then stand alone or be combined by region or island per analytical needs. The design thus focuses on number of sample sites (strata), time of day of sampling, and size of vessel to be sampled, leaving the number of number of trips, vessels, and fishermen to be determined empirically.

ORI projects six sampling strata would be needed on Oahu, where, for example, six interviewers would be engaged for 110 seven hour days for a total of 4,620 person hours, under the guidance of one supervisor also working 110 seven hour days. One hour driving time is also allocated. This strategy is repeated for a projected eight strata on Hawaii Island, six on Kauai, seven on Maui, one on Molokai and one on Lanai (one supervisor for all of Maui County) for a total of 22,330 working hours for interviewers, 3,080 working hours for supervisors, and 3,630 total travel hours. Projected hours of effort needed for data entry and analysis are not provided.

Pan, Minling

1998 Multilevel and multiobjective programming model for Hawaii fisheries management. Ph.D. Dissertation, Department of Agricultural and Resource Economics, University of Hawaii at Manoa.

Pan provides a comprehensive piece addressing critical economic and management issues in Hawaii's marine fisheries. In the words of Pan (1998: abstract), "this study develops a multilevel and multiobjective programming model to assist decision-making in Hawaii's fishery. The multilevel aspect of the model incorporates objectives of both policy makers and fishermen . . . To depict the reality of the fisheries, the decision variable of the model is defined as effort by fleet, target species, area, and season. The model covers nine fleet categories, ten target species, five areas, and four seasons. CPUE includes targeted and bycatch species. A nonlinear relationship between CPUE and effort is incorporated into the model. . . Under various objectives or policy options, the current model provides optimum solutions by fleet mix and its spatial and temporal distribution, as well as harvest level of fish resources. First, the model applications indicate that the economic efficiency of the Hawaii commercial fisheries can be improved if the number of handline vessels increase and the longline vessels are more flexible in switching targets since the relative abundance of fish resources affects the choices on optimal fleet mix. Under profit maximization, fleet-wide profit could increase from the actual profit of $4.5 million to $17.96 million accompanied by a 14% catch and 41% effort reduction. Second, the multiobjective analyses showed that the degree of conflict between recreational and commercial fishing varies by effort level. At the current effort level, an increase of one recreational trip will reduce commercial profit by $12.14. Moreover, the study concludes that the area closure regime has reduced the conflict between commercial and

recreational fishing; however, it caused profit loss within the longline fishery due to catch reduction and lower operating efficiency. The upper bound of the profit reduction in the longline fishery is estimated at $0.70 million. However, this profit reduction could be mitigated if fishing outside the area closures provides compensation for catch reduction."

Of interest from the recreational perspective, Pan estimates the number of "non-commercial" troll and handline vessels active in Hawaii by extrapolating from Skillman and Louie's 1984 vessel inventory, and Hamilton and Huffman's 1997 cost-earnings survey. Pan eliminates other than troll and handline gear from both datasets to arrive at of 2,490 active "recreational" vessels. It must be noted that this figure represents both recreational *and* expense fishermen, depending on ultimate disposition of catch noted in the data. Here "recreational" refers to vessels involved in fishing but without any sale of catch. Pan cites Hamilton and Huffman (1997) to note (p. 49) that among 575 small vessel fishermen surveyed in 1996, about 28 percent fish for recreational purposes without sale of catch. The term "expense," on the other hand, refers to small-boat fishermen who do not consider themselves commercial fishermen but "who sell at least part of their catch, but [where] the revenue from fish sale does not cover all of their expenses" (ibid.) This group comprised 40 percent of Hamilton and Huffman's study.

Pan also calculated the relative proportion of *avid* and *occasional* recreational/expense fishermen, "avid" defined here as descriptive of persons taking more that 12 trips per year. Thus, it was determined that of Pan's estimate of 2,490 recreational/expense fishermen, only 543, or 82.5 percent, were considered avid pursuers of the activity. The author calculated the average number of trips across the fleet based on the recreational catch divided by the pounds per the specific trip. HDAR data indicate an average catch poundage of 63, while Hamilton and Huffman found a more conservative 41. Reconciling the ratio of this difference in her analysis, Pan suggests an average of 14 trips per year per vessel, for a total of 35,124 trips across the "recreational" fleet.

Pooley, Samuel G.
1993 Economics and Hawaii's marine fisheries. Marine Fisheries Review. 55(2): 93-101.

This paper provides a concise and comprehensive summary of the history and then current status of Hawaii's marine fisheries with particular attention to economics. Pooley indicates that while past and [then] present data collection processes provide vital statistics for management purposes, these are not comprehensive for all fisheries; hence, assessing economic factors and trends across Hawaii's varied fisheries is thus a complex endeavor.

The author reviews work to date addressing economic factors and trends in Hawaii's recreational, subsistence, and charter fisheries but notes (Pooley, p. 94) that "the NMFS Marine Recreational Fishing statistical survey, which has served as the basic yardstick for recreational landings (in weight and number, not value) across the mainland U.S. has not been conducted in Hawaii since 1981." Citing the survey work of Skillman and Louie (1984) and Meyer (1987), Pooley does note (p. 94) that 27 percent of boat owners sold a portion of their catch, 17 percent sold at least half their catch, 35 percent of catch was sold at market, 13 percent was sold "off market," 23 percent was kept for

home consumption, and 21 percent was given way to family and friends. Overall levels of the "recreational and subsistence" fleet are said to be difficult to assess, though Meyers (ibid.) estimated total catch in 1985 at about 21 million pounds, 10 million of which were sold—significant given that landings by the commercial small boat fleet were estimated at 5 million pounds in 1985 (p. 94). Pooley also cites a year-long survey by Hamm and Lum (1992) which determined that fish landed but not sold by recreational and subsistence vessels on Oahu amounted to 1.9 million pounds, accounting for 59 percent of total weight landed by the entire Oahu small-vessel fleet.

The monetary value of recreational and subsistence landings is difficult to assess (p. 94), especially given difficulties in quantifying their hedonic values. Nevertheless, Meyer (ibid.) estimated that the recreational and subsistence catch was worth $30 million (adjusted for inflation to 1990 dollars), but the hedonic value totaled over $335 million.

As regards participation in recreational and subsistence fishing in Hawaii, Pooley cites Skillman and Louie's 1984 estimate of 5,000 active small vessels, and Meyer's 13,200 participants, but suggests the later figure is conservation and that until a comprehensive survey is undertaken "the numbers will remain elusive" (p. 95). While no work has been completed to fully address valuation of the subsistence fishery by its participants nor to estimate the monetary value of the subsistence catch, Pooley makes clear the importance of both in Hawaii.

The author also reviews (p. 95) the works of Samples et al. (1984), and Samples and Schug (1985), both of which address economic aspects of Hawaii's charter fishery. The direct market annual value of the 120 vessel fleet fishery was estimated to be $8.5 million (inflation-adjusted), and that fleet reportedly took 75,000 trips per annum during the early 80s.

Pooley, Samuel G.
1993 Hawaii's marine fisheries—some history, long-term trends, and recent developments. *Marine Fisheries Review*, 55(2): 7-19.

This concise but comprehensive review of Hawaii's fisheries describes historical and contemporary biological, economic, and social aspects of Hawaii's charter, recreational, subsistence and part-time fishing sectors. With respect to recent years, the author notes (p. 9) that during the 80's Hawaii had "a $10-15 million charter boat industry, probably an equivalent valued tournament fishery, and...a recreational and subsistence fishery with direct expenditures of $24 million." As regards participation during this period, he notes (p. 14) that "while there were 15,00 registered (or documented) boats in Hawaii in the 1980's, only 5,000 to 7,500 were used for fishing (Skillman and Louie; Sumida et al.; Meyer Resources Inc.). Pooley makes further assessments of the period, asserting that "less than 2,00 vessels were registered for commercial fishing [illegible] while there are less than 3,500 people holding commercial fishing licenses [illegible] there are perha[illegible]y 500-750 b[illegible] that could be considered full-time commercial and charter [illegible] operation[illegible]

The author discusses the problematic nature [illegible]entiati[illegible]'s "re[illegible]l" and commercial fisheries, noting, for instance, that m[illegible]angen[illegible]vaii e[illegible] even the casual fisherman to sell part of the catch. Th[illegible] also [illegible]. 15 [illegible]us efforts

undertaken to estimate the nature and extent of recreational fishing, including the 1979-1981 NMFS Marine Recreational Fishing Statistical Survey, a subcontracted effort that combined telephone and creel intercept methods to generate unpublished results. This study indicated 620,000 fishing trips taken by private vessels, and 88,000 taken by charter vessels during 1980. The estimated weight of "recreational" fish caught during 1980 was 4.4 million pounds, 94% of which was from boat fishing (the remainder caught from shore).

Pooley reports (p. 16) that a joint NMFS/DAR survey conducted in 1987 (Skillman and Louie; Sumida et al.) found that of state-registered vessel owners who fished that year, 70 percent said they never sold any of their catch, and only 16 percent sold at least half their catch. A 1987 DAR survey of commercial fishing license holders (30 percent of 2,529 license holders replied) revealed that at least 80 percent of license holders on each island earned less that 51 percent of their gross income from fishing (ibid.).

Samples et al. worked on a series of charter boat research efforts in the 1980s. Notable among the findings were that the 119 vessel 1982 charter fleet generated 73,780 passenger trips with a direct income of $8.1 million, a total catch of 2.2 million pounds, and with patron expenditures directly related to fishing totalling $39 million (p. 17). Finally, Pooley reports on a 1987 study by Meyer Resources, Inc. which utilized a contingent valuation technique with recreational fishing club focus groups to estimate 6,684 small vessels in Hawaii were used for fishing by persons "not making their primary living from commercial fishing," with direct expenditures of $24 million, and total catch of 21 million pounds (p. 17). Of the estimated catch, some 47 percent was sold, 23 percent was used for home consumption, and 21 percent given away to friends and family. The reported non-market value of these trips was $239 million.

Pooley, Samuel G.
1992 NMFS Hawaii pelagic fisheries data program. Unpublished paper. Honolulu.

This document furthers the position paper reviewed above to describe means for establishing a NMFS data collection program for all pelagic fisheries in Hawaii. The proposed program would reportedly serve to "maintain productive fisheries and to provide accurate and precise fishery forecasts and ecosystem models so that management and economic decisions can be made more proactively and comprehensively, and can result in the wise use of fishery resources" (p. 2).

The proposed program would collect dealer and vessel information so as to allow reliable estimates of catch and effort, average price, and average CPUE for each major pelagic species and gear type. This would include a *mandatory* logbook reporting requirement for all commercial harvesters and a *non-mandatory* requirement for recreational and subsistence harvesters who would be surveyed by mail and port intercepts, with directed focus on components of the fleet which catch the most fish and which have the most significant reporting problems (p. 7). Reporting of non-pelagic catch by commercial boats would continue under the existing HDAR system. One of a total of five port agents would be situated on each of the main islands to help implement and verify reporting of pelagics through port sampling, and a trip ticket system would require "first level dealers" to report purchases, sellers, species, weight, price, and revenue (p. 10). Further, the system would require "a substantial enforcement and compliance presence" (p. 11).

Pooley defines components of Hawaii's pelagic fishery as subsets of the universe of 15,000 boats registered and/or documented in Hawaii. These components include classes of vessels by gear and type of fishing activity, including the following (as of 1992): (1) longline and aku boats (n=170), (2) full-time commercial handline (ika-shibi and palu ahi; "n=250?"), (3) full-time commercial trollers ("n=100"), (4) charter boats ("n=200"), (5) other full-time commercial boats which land pelagics ("n=50"), (6) part-time commercial pelagics, any gear ("n=500 to 1,500?"), and (7) recreational and subsistence pelagics (no catch sold), any gear ("n=4,000"). The author also describes the surrounding market as it existed in 1992, noting that

> There are approximately 150 wholesale/retail seafood dealers (including brokers) in Hawaii, 15 grocery chains, approximately 300 independent grocery stores, and perhaps 100 restaurants which are major purchasers . . However, the vast majority of Hawaii-caught fish is purchased by a small number of dealers in urban areas (less than 20) and a variety of stores and restaurants in rural areas (less than 100) (Pooley, pp. 8-9).

As regards recreational and subsistence fishery data collection and analysis, Pooley suggests (pp. 11-12) information should be recovered from anglers, clubs, and tournaments, and should include attitudinal data and data related to the costs of fishing operations. The objective here is to provide a "continuously updated baseline of information on components of the fisheries not covered by the existing data collection systems, and to "dovetail with the port sampling required under the part-time commercial component of the data program" (p. 12). Reporting is central to the proposed program, and Pooley notes that information would be generated on an ongoing basis and disseminated to managing entities, commercial harvesters, dealers, and subsistence and recreational participants.

Pooley, Samuel G.
1991 NMFS Honolulu Laboratory position paper on Hawaii pelagic fisheries information. Unpublished. Honolulu.

This position paper reviews key issues and potential costs and benefits related to implementation of a NMFS proposal to assume and revamp HDAR's system for collecting, compiling, and reporting on data about Hawaii's small boat pelagic fisheries. The proposal results from perceptions that data and/or specialized data summaries about the small boat pelagic and bottomfish fleets are not readily available for timely council decision-making. Pooley notes, however, that the issue is primarily one of data collection and analysis and not compilation, and that jurisdictional considerations limit NMFS interest to pelagics only.

Pooley asserts that a central concern for small boat pelagic data issues is fishermen's lack of compliance with existing law. That is, the author believes HDAR catch reports *could* provide "a large measure of adequate information for Fishery Management Plan (FMP) monitoring, *if* there was "adequate compliance to the existing reporting requirements (particularly if augmented by dealer reports also currently required by state law but also of insufficient compliance)" (p. 4). Other significant problems are said to include (1) the fact that neither recreational landings nor

socioeconomic data are addressed by the HDAR system; these represent a "major vacuum in terms of meeting council needs;" (2) NMFS Honolulu Laboratory, NMFS Pacific Islands Area Office, and HDAR do not have sufficient temporal, human or fiscal resources to fully utilize existing data; (3) the planning teams "have not played an adequate role in defining what summaries and analyses need to be conducted;" and (4) the council has different perceptions and priorities about data needs and analyses than do the "line agencies" (p. 6).

The author offers some solutions. These include (1) maintaining the [then] status quo of reliance on HDAR commercial landings data with assistance from WPacFIN; (2) supplementing HDAR data with federal or federal/state recreational sampling; (3) supplementing HDAR data with enhanced enforcement; (4) revitalizing/computerizing the seafood dealer reporting system; (5) developing a state-federal partnership or cooperative institution that would work through data collection and compilation issues; and (6) federal data collection and compilation. Solution 5 is seen as least desirable in that it is perceived to be relatively expensive and cumbersome (p. 9). Solution 6 is seen as divisible into two alternatives. First, federal port agents and a logbook system for highliner commercial fishing vessels would be implemented. According to Pooley (pp. 9-10), this would involve: "better measures of total fishing effort and validation of HDAR data through port and dealer sampling . . it would also involve recreational, subsistence and socio-economic sampling." A second alternative would involve federal data reporting requirements, including port agents and enhanced enforcement capabilities. This is the main component of the NMFS proposal, and would incorporate recreational, subsistence and socioeconomic sampling (p. 10).

The NMFS pelagic data program proposal reportedly identifies three components to a "federal system of pelagic fisheries data collection in Hawaii" (p. 10). These are (1) an integrated approach to implement systematic and continuously updated baseline sampling of recreational and socioeconomic data; (2) hire of a fishery information specialist at NMFS Hawaii responsible for meeting council informational needs; and (3) an upgraded overall federal fisheries data collection, compilation, and reporting system for pelagic and bottomfish in the main Hawaiian Islands. Pooley notes the potential costs and benefits of the proposed program (p. 12). Potential costs include requisite fiscal allocations, a substantial growth in federal presence and possible ruffling of state-federal relations, a break in the HDAR time-series, and potential deflection of the main mission for the Honolulu Laboratory. Potential benefits include data quality control, more thorough and expanded coverage of commercial fisheries, coverage of recreational fisheries and collection of socioeconomic data, public perception of meeting MFCMA responsibilities, and better council-line agency relationships.

Consideration of these potential costs and benefits leads the author to conclude (p. 13) that the best use of Federal funds in this case would be to augment independently but cooperatively the extant HDAR data system. This would involve (1) expanding federal enforcement efforts to increase compliance with existing state reporting requirements, (2) federal sampling of the recreational fisheries, (3) use of a fishery information specialist to meet Council informational needs, and (4) federal port sampling to augment HDAR data (including collection of socioeconomic information). Pooley notes (p. 14) that proposed NMFS involvement in small vessel pelagic data collection would focus on augmentation and improvement of the existing system and avoid duplication of effort.

Pooley, Samuel G.
1991 Marine fisheries social science research priorities. Unpublished. NMFS Honolulu Laboratory. Honolulu.

This brief paper offers the author's insights on potential contributing roles for social science in Hawaii fisheries management. Pooley notes (p. 1) that to date (1991), social science contributions had been limited to (1) reconceptualization of management (e.g., ITQs and limited entry, enforcement economics, and non-commercial valuation), (2) analysis of economic processes, and (3) *ex post* justification of policy decisions. But he notes other possibilities and directions, stating (pp. 1-2)

> The most important role of social science research would be in understanding the behavior of individuals and groups in the fishing community, particularly in terms of understanding changes in human behavior due to regulation (*ex ante* and contrapositive) and exogenous events. This requires a fact-based micro approach to social science research, not a continued academism based on abstract models of fishing behavior.

The temporal and fiscal requirements of this brand of research, however, are recognized as historically problematic, given the relatively "short term agendas of fisheries management bodies" (p. 2). Pooley offers three approaches toward implementing "behavioral research," retrospectively defined as real on-ground activity of anglers in natural settings (Pooley 1999, personal communication, NMFS Honolulu): (1) integration of NMFS, Sea Grant, and relevant university entities with fishing communities, (2) a "medium-term social science research task force concentrating on simulation-based approaches" to management issues; and (3) an annual workshop/conference for social scientists addressing applied research and education with "representation from all fishery management regions" and social scientists in associated fields. Although the author recognizes such effort is not without cost, he notes that the "incremental costs of these [new] approaches would still be trivial compared to the overall cost of natural science research in fisheries" (p. 2).

Pooley, Samuel G.
1990 FMP monitoring and assessment workshop report. Southwest Fisheries Center Administrative Report H-90-05.

This report presents the results of the Fishery Management Plan Monitoring and Assessment Workshop of November 1989. The workshop involved review of basic assessment methodologies, expert perspectives on stock assessments, NMFS threshold levels of fishery biomass, and examination of fishery indicators as a better approach for synthesizing annual assessment information. Discussion of bottomfish and pelagic fisheries included development of criteria for designing fishery indicators and examination of the data used to determine the indicators. Experts included representatives from WESPAC, NMFS, HDAR, Guam DWR, CNMI DFW, and American Samoa DMWR.

With respect to stock assessment, participants noted the following lessons from experience: "(1) Identify clearly the assessment objective, (2) understand the fleet dynamics of the fishery, (3) understand the bio-dynamics of the fishery, (4) engage in critical and skeptical evaluation of assessment methods and data, (5) develop feedback loops between data, assessment methods, and objectives, (6) identify threshold values early in the fishery, (7) appreciate the uncertainty of values and data, and (8) recognize the importance of a holistic approach, rather than just the pieces" (p. 15).

Workshop participants identified the key features of a fishery indicator approach. These are as follows: "(1) a framework based on the dynamics of the fishery is required, (2) data should be used regularly (or adequately stored or catalogued), (3) biological knowledge of the fish, (4) identify key indicators and assign priorities, (5) quality time-series data, (6) link indicators to their biological (or economic) meaning and to their "critical values," (7) link indicators to management objectives, (8) define the "problem" the indicator should reveal, (9) annual reports should not be annual data reviews, and (10) identify the analyst who will use the indicator" (p. 16).

Workshop participants arrived at recommendations to supplement FMP bottomfish and pelagic indicators. Recommendations for the bottomfish FMP include the following: "relative spawning stock index, catch rates from high-liner vessels used as markers, biomass of recruitment cohort, index of fishermen's confidence in resource status, ratio of male to female landings relative in size groupings, index of researcher confidence in resource status, travel time to fishable stocks grows substantially as a proportion of total time at sea, synopsis of overall size range of individuals species, and index of stock recovery after overfishing" (p. 19). Recommendations for the pelagic FMP include the following in rank order: "(1) size statistics use length frequencies (mean, maximum and minimum, (2) Mr. Cruz index—an index of localized catchability based on the fishing experiences of the average small-boat fisherman in any particular area, ratios of CPUE by gear, index of species-gear-season CPUES stratified by size class, recreational CPUE trends (including size trends), Pacific-wide catch and effort index, comparison of Pacific versus local abundance and effort, price trends, and index of effort by area and gear" (p. 20).

Pooley, Samuel G.

1988 Kahului small fishing boat facility: alternative net benefit estimates. Southwest Fisheries Center, Honolulu Laboratory manuscript MRF-004-89H, report prepared for U.S. Army Engineer Division, Pacific Ocean.

This report uses results from a 1987 survey of commercial fishing boat owners conducted by the U.S. Army Corps of Engineers (USACE) to estimate potential economic benefits of an improved small vessel facility at Kahului Harbor on Maui. The work responds to public review comments on an earlier study that revealed specific limitations inherent in historical data about commercial fishing in the area.

A total of 385 surveys were mailed and another 80 were distributed to fishermen through state officials and boat clubs with the intent of better understanding catch and effort levels among small vessels active on Maui. The mailing covered persons who had attended public review meetings and all persons who had a commercial fishing vessel registered with the Harbors Division. Of the 110 surveys returned, 87 were suitable for analysis, the remaining 23 were from fishermen no longer

owning vessels or who did not want to provide information about their fishing practices. Of the 87 respondents, 16 were considered full-time fishermen, defined as persons landing at least 10,000 pounds in 1986. The remainder were part-time fishermen who sold part of their catch.

Given that the study sought to identify potential economic benefits resulting from construction of the ramp facility at Kahului, analysis focused on generating optimized and constrained models of benefits potentially accruing to Kahului area fishermen specifically, and to Maui fishermen generally, with and without project scenarios and in relation to the troll, handline and bottom resource bases. The estimated increase in annual number of Kahului trips *with* the project was 1,360 trips (from 685 to 2045), with subsequent adjustments made to overall Maui catch. Model equations included revenue, fixed costs, operational costs and parameters, number of trips per year, and catch per trip in pounds.

While the optimized, unconstrained and fully constrained models, and the avid assertions of area fishermen all suggest significant net benefits would accrue from the project, Pooley states (p. 23), "It is an unfortunate fact that the biology of Hawaii's marine resources seems to limit their exploitation by small fishing vessels, despite the apparent breadth of our oceanic surroundings." Thus, although the ramp at Kahului was determined to offer net benefits to Maui's commercial small vessel fleet, with the level of benefit depending on model of analysis, the capacity of the resource base was the limiting factor in each case.

Pooley, Samuel G.

1988 Report on Oahu small boat harbor fishery potential -- Heeia Kea and Maunalua Bay. Southwest Fisheries Center, Honolulu Laboratory manuscript MRF--005-89H, report prepared for U.S. Army Engineer Division, Pacific Ocean.

Pooley estimates potential net revenue benefits accruing to commercial and subsistence fishermen through expansion of mooring and launching facilities at Maunalua Bay (Hawaii Kai) and Heeia Kea in Kaneohe Bay on Oahu. The author notes that statistical information for both sites was limited to HDAR commercial landings data and a USACE site survey conducted in 1985, and that since neither was adequate for providing a comprehensive benefit analysis, the subsequent estimates should be considered as provisional. Further, since Maunalua had no moorage facilities, with and without project estimates for moorings were particularly weak.

HDAR data revealed an average of 535 commercial trips taken from Heeia Kea from 1983-1986, and 1180 of same from Maunalua. USACE survey extrapolations suggested 1,855 annual trips from Heeia Kea and 1,370 from Maunalua. Pooley estimated the catch rate for vessels at Heeia Kea at 302 pounds per trip over 1540 trips, and 210 pounds per trip over 3400 trips at Maunalua.

The author uses a combination of HDAR and USACE data, with considerations of findings from a similar study at Kahului on Maui, to generate with and without project fishing conditions at both Heeia Kea and Maunalua. Net annual benefits accruing to 41 commercial and subsistence vessels at Heeia Kea *with* the project are estimated at $1,059 per vessel. This figure, however, does not reflect the potential effects of reduction in catch rate resulting from increased fishing activity under

with project scenarios; Pooley notes the resource density effect could have very significant negative effects on benefits already calculated as minimal.

Given data inadequacies, benefits potentially accruing to Maunalua vessels under the *with* project scenario were calculated through a contingent valuation approach. Based on the USACE survey and using adjustments based on HDAR data, Pooley estimated some 72 commercial or subsistence vessels used the facilities at Maunalua and that the project would yield $32,032 in annual benefits across the fleet. While improvements to Maunalua might have improved access to Penguin Banks, it was noted that area was then already fished to or beyond its capacity. Pooley concludes (p. 9) that while there are many legitimate reasons to support improvement of mooring and launching facilities for small vessels on Oahu, "it is extremely difficult to do so on a commercial fishing operations basis."

Pooley, Samuel G., Jim Baxter, and Wesley K. Higuchi
1989 East Hawaii commercial fishing mooring and launching facility project: economic and resource analysis. Southwest Fisheries Center, Honolulu Laboratory manuscript MRF-006-89H, report prepared for U.S. Army Engineer Division, Pacific Ocean.

This comprehensive report was prepared for USACE to aid in assessing potential benefits of alternative mooring and launching facilities in the Cape Kumukahi-Poihiki area of Hawaii's eastern shore (the Big Island). Analyses derive from five primary data sources, including the 1983 NMFS vessel inventory, HDAR commercial landings records from the period 1970-1983, the 1982 NMFS cost-earnings study, the USACE survey of vessel owners on the Island of Hawaii (1985), and the "Corps Hilo Area Comprehensive Study" (1980). *With* project alternatives included an improved launching ramp or light draft harbor for trailered vessels at either Cape Kumukahi, Poihiki, or in Hilo Bay. Potential benefits would derive from the cost-minimizing benefits from reduction of travel time to fishing grounds in this area of intense commercial activity (viz., trolling and ika-shibi), and revenue enhancing-benefits resulting from reduced fishing, storage and handling time.

Using data from the 1984 vessel inventory, Pooley et al. report that there were about 1,360 fishing vessels extant on the Big Island at the time of writing, about 400-500 of which were commercially active (defined as earning over 50 percent of income from fishing). Using analysis of zip codes, the research team determined that a total of 706 vessels were active on the East side of Hawaii (between Honokaa and South Point), some 190 of which were commercially active. Most vessels in both categories were trailered vessels.

The report reviews and summarizes exhaustive analyses of project scenarios. Emphasis is on background analysis with focused profiles of existing fishing practices (including coverage of vessel characteristics, commercial landings, landings by gear type, fishing area, species composition and seasonal distribution), and resource availability. Benefit analysis includes coverage of individual vessel operating characteristics; costs and revenues; site parameters, and vessel benefit estimation. Net benefit analysis is also conducted *across* the fleet, This includes economic baseline estimates and sensitivity analyses.

While the authors note a strong demand for improved launch facilities in the area, they assert various reservations in recommending the project; potentially changing economic climates and faltering resource conditions make allocation of funds a risky venture. A net positive economic gain to the commercial component of the fishery and/or a net hedonic benefit from the recreational component would necessarily be required to offset project costs in order for the project to go forward. Despite risks, the authors accentuate the promises of improved facilities. Pooley et al. report (p. 70):

> Existing information shows that commercial fisheries on East Hawaii can make substantial profits, and that those who don't may obtain substantial lifestyle benefits. We are avoiding the measurement of the latter category of benefits but their existence ameliorates the danger that the net benefits of the project may not be fully manifested. Furthermore, with unemployment rates still high on the Big Island, and with alternative employment possibilities increasingly at lower income levels, the opportunity cost of fishing employment may be low . . The economic situation in East Hawaii could use a boost, and the commercial facilities could also use improved facilities. This report suggests that infrastructural improvements could play a considerable role in developing the benefits of East Hawaii's offshore commercial fishery.

Sakoi, Kenneth R.
1991 Estimating the net-economic value of blue marlin in Hawaii. Unpublished Report. NMFS, Southwest Fisheries Science Center, Honolulu.

Sakoi reports on a survey of four "recreational angler groups" conducted between June and December 1990 to assess personal valuation of fishing for blue marlin in Hawaiian waters. The groups were (1) charter patrons leaving from Kewalo on Oahu, (2) charter patrons leaving from Honokohau on the Island of Hawaii, (3) persons operating privately owned boats for "recreational" angling purposes from a variety of Oahu ports, and (4) persons operating privately owned boats for "recreational" angling purposes from Honokohau.

Sakoi counters Meyer's (1987) statement that "the willingness to pay concept is totally foreign to the existing circumstance in Hawaii," asserting instead that residents actually do pay to fish for marlin in Hawaii through taxes and other fees (e.g., taxes cover fish aggregating device programmatic costs) and so are capable of responding to WTP queries. Thus, the survey employed one open-ended WTP question for charter patrons, and one for persons running their own boats, to examine how and to what degree each group values fishing for marlin. A set of demographic questions were also included, and a combination dockside-mailback technique similar to that used by Samples and Schug (1985) was used to implement the instrument. However, the author states that various fielding problems and the possibility that charter owner/operators feared the survey could hurt their businesses led to what is perceived (by Sakoi) as a low response rate (57 percent), and ultimately to failure in assessing WTP scenarios "in a meaningful way, statistically speaking" (pp. 10-20).

Fielding and analytical problems notwithstanding, Sakoi provides some limited results, noting, for instance, that among the 73 usable responses from the private angler group, 43 percent indicated a positive or "true zero" WTP bid, while 57 percent did not offer a bid. Among non-bidders, 14 percent felt there was not enough information provided in the questioning, 19 percent responded that they were not sufficiently familiar with blue marlin to provide a thoughtful answer, 12 percent refused to give a dollar amount, five percent had "other" reasons for not offering a bid, and seven percent did not answer at all (p. 27). Comparable results were not provided for charter patrons. Regression analysis revealed that demographic variables did not explain variation in WTP with statistical significance.

Samples, Karl C.

1986 A Socioeconomic Appraisal of Fish Aggregation Devices in Hawaii. Sea Grant Marine Economics Report. UNIHI-SEAGRANT-ME-86-01. Contribution No. 33, State of Hawaii, Department of Planning and Economic Development, Ocean Resources Branch.

Samples (1986) provides a comprehensive socioeconomic assessment of FAD usage based on a UH Sea Grant-funded mail survey conducted with 622 fishermen who visited fish aggregating devices (FADs) during a 12 month period between 1983 and 1984. The author notes that subsistence and recreational fishermen had been asked by DAR to report fishing effort and catch at the FADs on a voluntary basis but that reporting had been sporadic. The sampling frame was comprised of the 1,705 FAD users identified in Skillman and Louie's 1984 survey of 12,578 registered boat owners, 72 percent of whom reportedly used their boats to fish. The frame was stratified in terms of operational characteristics of the fishermen, labeled as "recreational" (reporting no catch sold), "mixed" (reporting less that half of catch sold), and "commercial" (reporting more than half of catch sold). The recreational component comprised 51 percent of the total, the mixed group 18 percent, and the commercial portion 31 percent. The randomly selected sample size was set at 800 fishermen "in anticipation of an 85 percent return rate," and to ensure a 95 percent confidence interval for analysis (p. 3). Names and addresses were available from the original dataset to allow mailing of the survey.

An initial mailing and three successive follow-up mailings ultimately generated a response rate of 78 percent. Across-island proportions approximated the actual geographic distribution of registered vessel owners by island of residence and the relative population size of each island (p. 4).

Samples reports (p. 5) that the typical FAD user is a 43 year old male with a high school education and some college training and that "more than likely he is a skilled worker or a self-employed businessman with an annual household income of $30,000." This profile was reportedly consistent across the three user groups. In terms of FAD user vessel characteristics, Samples found that most vessels were in the 18 to 27 foot range, with an average of 20 feet. About six percent used boats bigger than 27 feet and 68 percent of these were used by the commercial group (p. 5). Boats used by the recreational component tended to use outboards with relatively less horsepower. No significant difference between groups was noted in average distance at which fishermen fished from shore.

The fishermen made an average 26.4 visits to FADs during the period and caught an average of 4.4 fish, mostly aku, and to a lesser extent ahi. In sum, there were statistically significant differences between persons with different operational motives to fish at the devices in terms of vessel type, catch, and opinions about FAD effectiveness. The author notes that fishermen generally claimed fish catch and fun were improved around FADs, but that crowding was a problem. A cost-benefit analysis revealed the user groups were willing to pay slightly more than actual FAD programmatic costs to enjoy the benefits (p. 36).

Samples, Karl C. and Donald M. Schug

1985 Charter fishing patrons in Hawaii: a study of their demographics, motivations, expenditures and fishing values. Southwest Fisheries Center Administrative Report H-85-8C. Honolulu.

Samples and Schug report on their NOAA-funded project undertaken by the Hawaii Institute of Tropical Agriculture, University of Hawaii, to examine the motivations of charter patrons, to relate these to attributes of the charter boat fleet, and to estimate the market and non-market demand for charter boat fishing in Hawaii. Estimates and analyses derive from a survey of charter customers at Kewalo Basin which consisted of short dockside interviews with 732 patrons and a total of 457 completed mail-back questionnaires. The sample size was based on an approximated total of 74,000 charter trips taken during 1983, some 16,700 of which were taken on Oahu (see Samples et al. 1984). Of note, Samples reports (p. 2) that during 1982, the 119 vessel charter fleet generated sales of just over $8 million and landed an estimated 2.2 million pounds of fish, or about 15 percent of Hawaiian landings. Blue marlin accounted for roughly one-third of landings by weight.

The report reveals (p. 8) that 83 percent of patrons were visitors, with a large number of Canadians. There was also a high incidence of high income males, particularly in the 25-44 age cohort, and a relatively low level of charter involvement, the average being less than one trip per year. Charter fishing was reported to be a relatively insignificant factor in people's decisions to come to Hawaii. With respect to motivations to fish, patrons desired a recreational activity above a successful fishing trip and were typically satisfied with their trips even in the absence of landed fish. Aku, ahi and mahi-mahi were most frequently caught, though the average number of fish caught per boat per trip was under three. One out of ten anglers caught a billfish.

With respect to economics (p. 34), patrons spent an average of $129 on full-day trips, and $104 for half-day trips. Visitors spent 43 percent more than residents for all trip-related expenditures. Patrons spent over $6 million for charter fees in 1984, and $39.4 to cover indirect costs. The annual consumer surplus value of charter fishing was estimated at $4.2 million or $57 per trip. Hedonic price analysis revealed that prices charged for full-day share trips are sensitive to marlin catch rates and vessel service features. Contingent ranking showed (pp. 64-65) that patrons were willing to pay an additional $65 in fees if the chance of landing a 250 pound marlin increased by 65 percent above then current Kewalo catch rates, but only $4 more to catch a mahi-mahi. While results suggest that patron satisfaction is closely tied to the possibility of catching a billfish, marlin catch rates were not expected to influence demand for charter services since historical catch rates did not seem to influence trip-taking behavior (nor is it readily available to potential patrons), and because catching fish was not the sole purpose for taking the charter trip (p. 69).

Samples, Karl C., James N. Kusakabe and John T. Sproul
1984 A description and economic appraisal of charter boat fishing in Hawaii. Southwest Fisheries Center Administrative Report H-84-6C. Honolulu.

This report provides results from a 1983 study of Hawaii's charter vessel fleet conducted by the University of Hawaii Institute of Tropical Agriculture and Human Resources. Mail and follow-up phone surveys were used to assess and describe fleet characteristics as perceived by charter operators for their 1982 season.

With respect to enumeration of active charter vessels for sampling purposes, Samples et al. examined the NMFS vessel inventory, U.S. Coast Guard documented vessel statistics, and state Harbors Division statistics to identify 214 documented and registered "charter fishing vessels." Elimination of dual ownership led to a target population of 208 charter vessel owners. The total response rate to the three-wave mail survey was about 55 percent. The followup phone survey was conducted to determine the actual proportion of non-respondents who were bona fide charter vessel owners, and to determine the degree to which the sample for the mail survey was representative of the actual population of charter boat owners across the state (p. 5).

Based on survey results, the 1982 charter fleet was estimated to consist of 119 boats, operating from each of the main Hawaiian Islands (except Lanai and Niihau), with the majority operating from Kewalo on Oahu and Honokohau on Hawaii. The fleet ran an estimated 73,780 trips during 1982, most of which were full-day trips taken by visitors to Hawaii. Average full-day rates were $355. Over $8.1 million in total revenue was generated, with indirect sales resulting in an additional $8 million. The industry's direct sales reportedly (p. viii) compare closely with sales estimated for Hawaii's surf shop industry, and are higher than those generated by the dive industry. Direct charter sales comprise 0 .03 percent of total direct sales made in the State of Hawaii in 1982. The fleet employed 203 persons on a full-time equivalent basis and another 269 through indirect purchases from other economic sectors; total employment provided was about 0.04 percent of statewide employment. Some 2.2 million pounds of fish were landed, or about 15 percent of total commercial landings for 1982. Landings of blue marlin were 180 percent higher than those reported by the commercial fleet.

The report provides a wide array of economic, attitudinal and behavioral analyses. The authors suggest (p. ix) that while the charter industry is significant in biological and economic terms in its own right, it represents a relatively insignificant component of economic activity across all economic sectors statewide. The fleet is reportedly heterogeneous in terms of vessel operations and owner demographics. There was a notable level of vessel under-use such that, when averaged across the fleet, there was a significant before-tax operational loss during 1982.

Samples, Karl C. & SMS Research

1983 Experimental valuation of recreational fishing in Hawaii. Final Report. Southwest Fisheries Center Administrative Report H-83-11C. Honolulu.

Samples reports on a series of test surveys conducted to assess the feasibility of estimating the economic value of offshore recreational fishing in Hawaii. The results of the study are not intended to be representative of the true population of recreational anglers but rather to advance theoretical understanding of means for investigating recreational fishing economics in the contexts of management, development, and environmental assessment. Thus, the author develops measures for (1) the gross economic impacts of offshore recreational fishing in Hawaii, (2) its consumer surplus value, and (3) the responsiveness of recreational values to changes in catch rates, levels of congestion and availability of recreational substitutes (p. 3).

Samples et al. provide some justification for measuring the economic reach of Hawaii's recreational fishery, citing various sources to indicate the magnitude and social importance of recreational fishing in Hawaii in terms of both participation and landings. For instance, Hoffman and Yamauchi (1972) note that in 1968 some 15,000 persons engaged in offshore recreational fishing, with the 1976 Kailua-Kona recreational catch sold commercially for $260,000 (see Hoffman and Yamauchi's "Recreational Fishing: Its Impact on State and Local Economies, University of Hawaii, Department of Agricultural and Resource Economics Departmental Paper No. 3, Honolulu; and Cooper and Adams 1978). Samples et al. claim that the latter finding is not unusual in that the 1970 recreational landings for finfish approximated that of the domestic commercial fleet. Further, part of the catch was highly valued in that it was consumed as food or given to others, though this value is not quantified by the authors.

Another set of values noted as important was the "sizeable expenditures which anglers make on fishing vessels, food, tackle, fuel, beverages, accommodations, vessel repairs, and berth rentals" (p. 2). According to Samples et al., neither these expenditures nor the industry in general can be considered economically trivial; the authors cite Hoffman and Yamauchi who estimate the industry had a gross economic value of $2.6 million per year in 1968 dollars. The consumer surplus value or subjective value which anglers assign to their fishing activities was also considered significant and Samples et al. cite Adams (1980) who estimated an annual consumer surplus value of $1.6 million for the 386-vessel 1976 Kailua-Kona fleet.

Given the clear importance of the recreational sector, Samples assesses application of valuation approaches to Hawaii's offshore recreational fishery, potential sources of bias contributing to estimation error, and practical matters of prospective respondent's ideas about the worth of a survey effort and willingness to participate. A valuation survey instrument was pre-tested three times with 100 "recreational" fishermen at Waianae. The instrument was modified "considerably" each time. While the term "recreational" is not explicitly defined, Samples et al. later state that "fishermen who went out for commercial purposes were not included in the survey" (p. 8). This is contradicted when Sample states the following:

> . . . certain data reflect the fact that some sampled anglers are also engaged in commercial fishing activities. Of the fifty anglers queried about their status as commercial fishermen, 40 percent claimed to be

> licensed (Table 13). Of this group, 22 percent had sold fish during the past twelve months (Table 14). Due to the nature of the small sample size, the influence of commercial fishing status on angler's responses is impossible to statistically evaluate (Samples, p. 10).

There is further uncertainty about the relationship and definitions of "commercial" and "recreational" fishing in Hawaii:

> Survey data do not enable an estimate to be made as to whether fish sold commercially were caught while recreational fishing. Future studies should clarify this issue. One possible way may be to ask fishermen to state the purpose of their intercepted trip, and identify their disposition plans for their current catch (Samples, p. 11).

The situation is noted again:

> The question to qualify fishermen as 'recreational' elicited some form of resistance among respondents to define their purpose. Some respondents were afraid to say 'No, I'm a commercial fisherman,' because of the peculiarities of tax and legal implications of the commercial or semi-commercial fishing industry (Samples, p. 34).

The sample was subdivided so that each group of 50 participants was administered one of two surveys, the first addressing "vessel characteristics, use of alternative launch sites, total catch, valuation of a fishing day, and basic demographic characteristics," the second addressing trip-related costs, fishing-related costs over the course of 1982, attitudes about fishing and the quality of the experience, "valuation of a fishing season," and basic demographic characteristics (p. 7). It was determined that the subsamples were drawn from the same "underlying population," and so were treated as statistically homogenous (p. 8).

Instrument testing, conducted through an intercept process at the Waianae Harbor vessel wash area revealed the optimal survey length to be under 20 minutes; longer efforts resulted in attrition. Samples et al. caution that valuation questions should be constructed strategically to avoid ambiguity in response and non-response; participants generally had a difficult time understanding the hypothetical situational nature of the questions. The authors further recommend use of multiple valuation measures to enable assessment of internal reliability. Of the measures tested, willingness-to-pay and willingness-to-accept-compensation were said to yield the best results.

With respect to pilot study findings, all but one respondent was male, most between 35 and 44 years of age. Some 84 percent were employed, with a median income of $20,000. The mean number of trips taken over the previous year was 45, with a maximum of 180. Twelve percent of the sample took over 100 trips. Over 84 percent of the sample reported fishing around the FADs. While some 40 percent of anglers reported keeping records of catch, reporting of catch was based on memory; these data, however, are not described in the report. Crowding at launch and fishing sites appeared to influence satisfaction with the fishing experience, though 48 percent of respondents asserted that proximity to good fishing was central in decisions to launch from Waianae. The mean distance

travelled to launch site was 16.7 miles, with an upper limit of 60 miles. Mean length of fishing trip was 7.3 hours with an upper limit of 22 hours. Average trip costs were $104, including out of pocket expenses (typically shared with others) and maintenance investments. According to the authors (p. 37), the high rates of participation, significant annual expenditures, lack of identified substitutes, and strong reported attachment to the sport suggest consumer surplus is quite high.

Among the valuation measures tested, the fair price for launch fee yielded a high frequency response (42 percent) between one and five dollars. Some 28 percent suggested no fee should be charged. The high frequency response for minimum payment needed for respondents not to go fishing for one day was between $76 and $100. The high frequency valuation of fair price for an annual fishing license was the refusal category (no license—18 percent). The high frequency response for the minimum amount needed to forego offshore fishing for one year was between $7,501 and $10,000.

Samples et al. review a variety of multipliers and models and recommend a systems approach for reckoning the direct and indirect economic impacts of offshore "recreational" fishing in Hawaii. The authors further recommend adapting the inter-industry input-output model used by the Department of Planning and Economic Development to analyze survey data concerning fishing-related direct expenditures, output, and employment as these relate to recreational vessel owners.

Shomura, Richard S.
1987 Hawaii's marine fishery resources: yesterday (1900) and today (1986). Southwest Fisheries Center Administrative Report H-87-21.

Shomura uses data from 1900, 1950, 1953, 1985 and 1986 to develop a concise history of changes in commercial catch in the Hawaiian Islands. The author notes that despite "gross shortcomings" in the statistical database, fundamental changes have occurred and are discernible in the record of Hawaii's fishery resources and levels of catch. While changes are partly attributed to pressures resulting from the massive increase in Hawaii's population between 1900 and 1986, Shomura calls for studies to determine the most critical causal factors.

The author notes that there were about 154,000 persons living in Hawaii at the turn of the century including 2,159 registered commercial fishermen and an unknown number of artisanal fishermen (see J.N. Cobb, 1902 "Commercial fisheries of the Hawaii Islands," U.S. Comm. Fish and Fish., Rep. Comm., 1901, Pt. 27, p. 381-49.). Shomura cites Skillman and Louie (1984) to assert that by 1985 some 2,638 persons held commercial licenses, with the total number of active commercial and recreational fishing vessels at around 8,000.

Shomura underscores the fact that recreational and subsistence catch may have been significant during the period 1900 to 1986 but are not reflected in extant data. The author reports an 80 percent reduction in the catch of coastal species and a 44 percent reduction in netri-pelagic species, but a dramatic *increase* in pelagic catch between 1900 and 1953, attributed to changes in vessel technology. However, the pelagic catch of nearly 17 million pounds in 1953 was nearly twice the 1986 catch of over 8 million pounds, exemplifying the general direction of change in commercial catch across species and habitats.

Skillman, Robert A. and James C. Cooper

1984 Cross tabulations of catches of large pelagic species based on Hawaii commercial catch reports, January 1976 - April 1981. II. Species by area fished and fishing gear. Southwest Fisheries Center Administrative Report H-84-2.

This report provides extensive cross-tabulations and brief summaries for commercial catch of pelagics in Hawaii's Pelagic Species Management Unit. The focus is on species, with cross-tabulations addressing combinations of species, gear, and area fished.

For striped marlin, longline gear was most important for the period 1976-1979, but by 1980 trolling gear accounted for most of the catch. For blue marlin, trolling was most prevalent means for catch with longlining in decline but deep-sea handline increasingly important during the period. Longlining for swordfish was surpassed by deep-sea handlining, a category which included by-catch data from the ika-shibi fishery. Trolling gear was most prevalent for catch of ono and mahi though the proportion caught by deep-sea handline increased during the period. All species were caught in greatest proportion in the 2-20 nmi (nautical mile) zone. Shark catches revealed no consistent pattern in gear use nor area of catch.

Skillman, Robert A., James C. Cooper, and Daniel R. Locey

1984 Inventory of U.S. vessels in the central and western Pacific: Phase 1 -- Summary of Public Record. Southwest Fisheries Center Administrative Report H-84-8.

This summary report used then existing public records to enumerate fishing vessels in American Samoa, Guam, Hawaii, and the Northern Mariana islands. Given that records were inadequate, a second phase of the project was initiated using a survey instrument (described below).

Records of American Samoa vessels consisted solely of U.S. Coast Guard registration records from 1973, updated in 1976. The inventory included statistics for 155 vessels, addressing owner, usage, and boat type and size. The contractor reported the data as being incomplete, inaccurate, and out of date. Most vessels were unspecified for use but the largest usage category specified was for pleasure at 61 boats, with 32 outboard powered and 20 inboard powered. Ten vessels were identified as commercial fishing vessels; four used outboard engines, five used inboards and one used both (p. 6).

Guam's public record in 1981 contained information about 734 vessels, most registered with the Guam Department of Public Safety and about 30 vessels documented by the U.S. Coast Guard Public Safety Office. Data include information about owner, usage and vessel type. The contractor reported that while the inventory was nearly complete it contained many outdated records. Of the 734 vessels, 672 were categorized as "pleasure," 511 of these outboard powered. Nine were listed as commercial fishing vessels (p. 7).

The Hawaiian database included 16,612 state-registered, and 1,146 U.S. Coast Guard-documented vessels; all data were described as up-to-date, correct, and accurate. Data were tabulated and cross-tabulated for both documented and registered vessels (with overlap) by propulsion type, length,

length by usage, island by usage, island of residence of owner by usage, frequency of usage by type, usage by type of propulsion, fuel type by usage, fuel type by type of propulsion, and usage by hull material. The combined documented-registered usage by length of vessel table lists 8,392 pleasure vessels between 16 and 40 feet in length and 6,387 pleasure craft under 16 feet in length. A total of 1,450 commercial fishing vessels are listed (pp. 8-20).

Sources for vessel enumeration in the CNMI include the U.S. Coast Guard, which began registering vessels in 1980 and lists 32 Saipan vessels, and the DMR which conducted a survey in 1981 and lists 35 full-time and 105 part-time fishing vessels. Nine boats were counted on Rota by a subcontractor survey (date unspecified). All but 13 of the 145 CNMI vessels were outboard-powered (p. 21).

Skillman, Robert A. and David K.H. Louie
1984 Inventory of U.S. vessels in the central and western Pacific: Phase 2—verification and classification of Hawaiian vessels. Southwest Fisheries Center Administrative Report H-84-12.

Phase Two of the central and western Pacific vessel inventory employed a mail survey to (1) enumerate boats used for fishing versus boats used for pleasure, (2) verify that vessels in the existing public record were in fact still in use, and (3) classify boats by various fishing-related factors. The survey was mailed to persons who owned vessels registered with the state and/or documented by the U.S. Coast Guard in cases where said vessels might be used for fishing. The survey was intended to be as concise and as easy to complete as possible. The effort enjoyed a high response rate; only one mailed reminder notice was required.

Some 12,000 questionnaires were mailed out and 60.6 percent were returned (pp. 1-3). Results are described in Sumida, et al. (1985) as annotated below.

Skillman, Robert A., Daniel R. Locey, and James C. Cooper
1984 Cross tabulations of catches of large pelagic species based on Hawaii commercial catch reports, January 1976 - April 1981. Area fished and fishing gear by species. Southwest Fisheries Center Administrative Report H-84-1.

This report summarizes analysis of HDAR data for landings, sales and revenue for large pelagics from the period 1976 to 1981. The report provides tabulations and cross-tabulations for region fished by species, region fished by gear type, region fished by gear type by species, gear type, gear type by species, gear type by region, and gear type by region and by species.

According to the report (pp. 1-3), the zone from between two and 20 nmi offshore of the MHI was most significant for catch of large pelagics in terms of weight and revenue, with troll gear the most important, followed by flagline gear (tuna longline gear) from 1976 to 1979. Deep-sea handline surpassed flagline gear in importance in the zone from 1980-1981. Blue marlin was most significant in terms of weight in the two to 20 nmi zone but ranked behind ono and mahimahi in terms of revenue.

Ono was the most important species in the zero to two nmi zone in terms of weight and revenue, and mahi-mahi was second, though blue marlin was most important in terms of weight in 1978 and 1979. Troll and deep-sea handline were most commonly used in the zero to two nmi zone. In the NWHI, ono was clearly most significant in weight and revenue, and trolling was the most important gear type. Mahi-mahi was most significant for weight and revenue beyond 20 nmi across the MHI and NWHI; trolling was the most important gear type.

The largest catches in all regions were made with trolling gear and mostly comprised ono, mahi-mahi and blue marlin. Mahi-mahi and ono made up the bulk of the catch in weight and revenue for other gear types as well, though flagline gear caught more striped marlin. Trolling gear was designated as most important across all management unit species in terms of weight landed and revenue generated from 1976-1981, followed by flagline from 1976-1979, and deep-sea handline between 1980-1981. Inshore handline gear was designated as least important during the entire period.

Sumida, R.F., B.M. Ito, and J.P. Draper
1985 Inventory and uses of vessels in Hawaii, 1984. (A non-technical version of the verification and classification of Hawaiian vessels). Southwest Fisheries Center Honolulu Laboratory.

Sumida et al. report on a mail survey cooperatively implemented by WESPAC, NMFS and HDAR to inventory vessels registered in Hawaii in 1984. The concise survey instrument was mailed to 12,578 owners over two mailings, with a total of 7,042 returned for a high mail survey response rate of 60.6 percent. The sampling frame omitted owners considered not likely to engage in fishing, including sailing vessels and various commercial vessels (p. 3).

The authors report (p. 4) that 72.1 percent of respondents used their vessels for fishing though they note that generalizing this statistic to the entire power boat population may be problematic in that 40 percent of that population did not respond to the survey. Some 60 percent of respondents moored their vessels at one of the six major ports of Ala Wai (15.3 percent), Keehi Lagoon (12.3 percent) Hawaii Kai (8.8 percent), Kaneohe (6.5 percent), Kailua-Honokahau (5.6 percent), and Waianae (5.2 percent). Some sixty percent of vessels were "trailered and stored" at ten towns and cities, including Honolulu (18.5 percent), Kaneohe (10.7 percent), Kailua (5.4 percent), Hilo (5.2 percent), Pearl City (4.0), Waianae (3.3 percent), Aiea (3.1 percent), Kailua-Kona (3.1 percent), Waipahu (2.7 percent), and Kahului (1.9 percent).

Very few respondents (1.4 percent) reported using their vessels for charter fishing, and few (26.1 percent) of those who reported using their boats to fish also reported selling *any* of their catch. Thus, 70.2 percent of those respondents using their vessels to fish reported they *do not* sell any of their catch. Of persons selling catch, only 16.1 percent reported selling more than half, a fact interpreted by the authors to mean that "most are not truly commercial fishermen, since they sell less than half their catch" (p. 6). Only 2.9 percent of respondents reported earning more than half their gross income from fishing, and only 11 percent of respondents reported belonging to sport fishing clubs.

With respect to level of fishing activity across the sample, most respondents reported fishing between one and five days per month, with less activity in non-summer months. Most (48.8 percent) fished within three miles from land, but 42.8 percent fished farther offshore. Four fishing methods accounted for more than 50 percent of those reported: trolling accounted for 18.8 percent of methods, shallow handline for 13.6 percent, casting and spinning with rod and reel for 13.3 percent, and spearfishing for 9.1 percent. Most respondents (63.4 percent) reported they did not fish around FADs despite the author's contention that "public support of [their] deployment . . has been quite strong" (p. 11).

U.S. National Marine Fisheries Service

1983 The 1976-78 studies of the Kailua-Kona, Hawaii, billfish fishery: charter boat operators component. Southwest Fisheries Center Administrative Report H-83-4.

This report presents condensed and edited findings from a NMFS-sponsored face-to-face survey of charter vessel operators active in the Kailua-Kona area as conducted by Research Associates, Inc. during the period 1976-1978. The sample was drawn from membership lists of charter vessel associations in the Kailua-Kona area. Given the small size of the fleet at the time, the research team sought to sample it in entirety; in the end 25 of 29 active vessels were included in the sample. Data included vessel characteristics and operations; demographics; and investment, expenditures and revenue.

Data analysis revealed that all boat owners and operators were male, with a mean age of 41 years. Over half the sample reported charter fishing as their sole means of income, while the remainder reported 47 percent income derived from charter fishing. Some 75 percent of vessels employed two persons as full-time crew. The average number of full-day trips taken was during the calendar year 1976 was 97, with four vessels taking less than 50 trips and 13 making over 100 trips. The average fee for a full-day four-person charter was $239 (p. 4).

The average annual gross income for charter boat operation was $26,753, with an additional $2,400 received from the sale of fish. Mounting of fish provided additional revenue but, given an average per vessel expenditure rate of $31,476, most boats reportedly lost money. Salaries and wages topped the expenditure list, followed by repairs, commissions to booking agents, fuel and oil tackle, insurance, and boat payments (p. 6). As regards catch, aku were most frequently caught, followed by ono and mahi-mahi. Marlin accounted for the most weight landed at an average 7,230 pounds. Ahi generated the most revenue with an average of $1,865 (p. 13).

U.S. National Marine Fisheries Service

1982 The 1976-78 Studies of the Kailua-Kona, Hawaii, billfish fishery: commercial/recreational component. Southwest Fisheries Center Administrative Report H-82-3.

This report presents findings from a NMFS-sponsored face-to-face survey conducted by Research Associates with 200 Kona-Kailua-based commercial and recreational fishermen during the period 1976-1978. The final sample was drawn from a frame of 577 boat owners whose Harbors Division-registered vessels were over 14 feet in length, and whose zip codes were indicative of residence in the North and South Kona area. Although it is not clear whether there was some sort of screening mechanism for determining species sought, fishermen were interviewed only if they fished for the marlins, ono, ai, aku or mahimahi (p. 3).

A variety of data categories were addressed by the survey, including fishing practices and catch; disposition of catch; earnings and expenditures; demographics of participants; and fleet and vessel characteristics. Results were post-stratified in categories of commercial license holders, recreational fishermen, and subsistence fishermen. While 70 percent of the sample possessed a commercial fishing license, only 18 percent listed commercial fishing as their primary occupation. More than half of the sample realized secondary income from sale of fish.

The authors note (p. 7) that only 13 percent of the sample moored their vessels, mostly at Honokohau, with the most popular trailer launch site at Keauhou. While some 80 percent of the sample reported using their boats only for fishing, an average of 93 percent of all boat-use time was spent fishing. The mean number of fishing trips per annum was 69; 47 percent of respondents took less than 30 trips, while 22 percent took over 100 trips. The average trip lasted seven hours; 17 percent of respondents reported fishing over ten hours per trip. Ono was the most popularly caught species; 83 percent of the sample reported landing that fish over the course of the previous year. About 80 percent of the sample reported catching ahi. Aku was caught in greatest numbers (52 on average), followed by ahi (35 on average). Billfish were caught most infrequently (eight percent), a finding the authors contend is because "they have far less commercial value than other fisheries and therefore are fished for less often" (p. 10).

With respect to costs, the authors report expenditures exceeded earnings by over $1,800 in 1976. Expenditures exceeded revenue for both commercial license holders and non-license holders though the difference was less significant for license holders. Fuel and oil topped the list, followed by boat payments, gear, engine repair, and food and beverages. Some 88 percent of respondents reported conducting some of their own repairs and/or maintenance of fishing-related equipment. Commercial license holders spent close to twice as many hours per year (mean of 112 hours) in personally maintaining their vessels and gear than did non-license holders (mean of 57 hours). Total annual expenditures were nearly three times higher for commercially –licensed fishermen. There were positive correlations between length, horsepower, value of vessel, and level of intensity of fishing on one hand, and level of earnings made by fishing on the other. According to the authors (p. 21) catching and selling ahi was "the key to realizing any substantial income from commercial fishing.

Demographic analysis revealed the gender-specific nature of Kailua-Kona area fishing; 98 percent of the sample was male. The mean age of participants was 44 years, with the highest percentage (28 percent) working in trades or laborer occupations. About 37 percent of respondents stated membership in a trolling club (p. 15). Boat owners with commercial licenses reported investing more money in their vessels, taking more and longer fishing trips, and spending more time fishing with their boats than did non-license holders. Commercial fishermen also reported relatively better success rates at catching all species with markedly higher takes of ahi—3.5 times the weight caught by non-license holders (p. 17).

U.S. National Marine Fisheries Service

1983 The 1976-78 studies of the Kailua-Kona, Hawaii, billfish fishery: charter boat patrons component. Southwest Fisheries Center Administrative Report H-83-5.

This was the final of three reports presenting major findings from studies conducted by Research Associates from 1976-1978. This product describes the results of a face-to-face survey design conducted with a total of 59 charter patrons in the Kailua-Kona area and stratified by out-of-state visitors, state residents, and County of Hawaii residents. The report provides results of analysis for out-of-state visitors only, and considers whether patrons were visiting with tour groups or independently. The study addresses a wide array of demographic, economic, and experiential variables, including patron experience with charter fishing and Hawaii generally; the relative importance of charter fishing in deciding to visit Hawaii and vis-a-vis other potential tourist activities; the nature of the current visitor's stay in Hawaii; the likelihood of engaging in charter fishing and other tourist activities in the future; charter fees and various other fishing trip-related and general trip-to-Hawaii expenditures; and patron demographics.

Of the total 59 out-of-state survey respondents, 28 percent travelled as part of a tour group while 72 percent travelled independently. A total of 42 persons or 71 percent of the sample stated that they considered going deep-sea fishing prior to arriving in Kona. Going charter fishing was more important in deciding to come to the Big Island than it was in deciding to come to Hawaii (by 24 percentage points). Some 81 percent of respondents said they would not be fishing again during their stay in Kona but 49 percent said they would fish during their next visit (but with 41 percent undecided). Only two percent reported they would not fish again during their next trip. Nearly 94 percent of persons visiting with organized tour groups reported this was their first visit to Hawaii, but only 38 percent of independent travelers reported this as their first trip. Seventy-eight percent of respondents noted this was their first trip to Kona (pp. 9-15).

The average charter fee paid was $110 but was slightly cheaper for independent travelers. Eighty percent of patrons reported they did not tip their captain or crew; for those who did, the average tip was $13.71. Only eight percent of the sample reported fish mounting costs; the average was $248.00 (p. 16 and p. 29).

As regards demographics, fully 98 percent of patrons were male with a median age of 46.8 years. While most patrons (39 percent) reported themselves as being blue collar workers, the high frequency income bracket (25 percent) was more than $40,000 per year (p. 30).

U.S. National Marine Fisheries Service

1982 Fishery data needs of the National Marine Fisheries Service in the Hawaiian archipelago. Southwest Fisheries Center Administrative Report H-82-9.

The report contains statements regarding NMFS informational needs relative to national reporting requirements under the Magnuson Act, and fishery management-related research activities prior to implementation of WPacFIN. Among the data needs identified in the report are those involving (1) landings; (2) vessel information; (3) catch and fishing effort for each of the major fisheries of tuna trolling, tuna and billfish longlining, ika-shibi and palu ahi for large tunas, bottomfish and handline, spiny lobster, and precious coral; (4) stock size composition; (5) recreational fishing; (6) market data needs including that for wholesale dealers, processors, support industries, canneries, shippers; and (6) fish and shellfish species including the tunas, billfishes, sharks, mahi-mahi and ono, small pelagics, the shellfishes, and the bottomfishes.

With respect to recreational fishing, the report makes several notable comments. These are as follows:

> The NMFS has recently established a marine recreational fishing policy that includes the determination of the recreational community, catch, and fishing effort. For the most part, the latter two pieces of information are not now currently available in Hawaii and could, probably, only be obtained by conducting special studies. However, catch, fishing effort, and other data on subsistence fishers who sell at least part of their catch should be available from the state's Fish Catch Report. As for determining the recreational fishing community, several factors are involved. First, in the absence of a marine fishing licensing program, determining the numbers of persons by type of fishing activity can probably be best obtained by conducting surveys. Second, the number and type of sport fishing clubs should be obtainable by conducting an enumeration study. Third, the determination of supporting industries involves the identification of suppliers of equipment, gear, repair services, fuel, etc. and would require special, detailed surveys (NMFS, pp. 6-7).

Walker, Julie

1997 Sociology of Hawaii charter boat fishing. SOEST JIMAR Contribution 97-309. University of Hawaii.

Walker describes results of a face-to-face survey of 55 charter vessel captains and 24 crew. The survey addresses social and cultural aspects of Hawaii's charter fleet including its social organization, career patterns of participants, and the degree to which the industry approximates an "occupational community," as defined in the sociological literature. The author estimates a total of 150 charter boats were active in Hawaii in 1996, 95 of which were based in Kailua-Kona. Her sampling strategy thus reflects levels of activity at each of the major charter ports of Kona (59.7 percent), Kewalo (15 percent), Lahaina (10 percent), Lihue and other Kauai (5.7 percent), Maalaea (3.8 percent), other Oahu harbors (3.1 percent), and Molokai and Lanai (both 1.3 percent). Individuals were chosen for interviewing via "dockside intercept and snowball sampling" techniques, as described by the author:

> Although these dockside intercept and snowball sampling methodologies did not produce a completely random selection of people involved in charter fishing, there is no reason to assume that the 79 fishermen interviewed are not fairly representative of the entire population (Walker, p. 2).

Among the principal findings of the report, the author asserts Hawaii's charter industry exhibits most of the components of an occupational community: strong self-image, a reference group (interpersonal communication of about the work world of charter fishing), and "convergence of work and non-work social groups" (p. 41). Yet she also states that hard economic times have led to a climate of fierce competition and minimal organizational cohesion across the fleet, and that "tough times" underlie fishermen's reportedly negative perceptions about possible management options. Walker suggests a need for fisheries managers to recognize the financial, experiential and geographic diversity inherent in the industry, and the different ways in which captains, crew and operators (including owner-operators, active owners, and absent owners) address economic uncertainties inherent in the charter business. The author also suggests that industry participants would themselves benefit by putting aside competition-driven differences so as to further presentation of a unified voice to government in the future interest of the charter fleet.

Walker, Julie

1996 Work and leisure in Hawaii small boat pelagic fishing. Thesis for Masters of Marine Affairs, University of Washington. Seattle.

Walker conducted a series of informal interviews with key informants, open-ended interviews with 48 fishermen, and an unspecified period of participant observation to develop a sociological analysis of work and leisure in Hawaii's small vessel troll and handline fishery. The focus of the work is on verification of a typology of fishing trips, and exploration of the notions of instrumental and expressive work and leisure in fishing. Categories describing behavioral aspects of fishing trips are

constructed *a priori* explanations about how various informants fit those categories. Thus, Walker discusses instrumental and expressive work in charter and "profit" fishing, and casual and serious leisure in expense, sport, and "holoholo" fishing (the latter defined as purely recreational fishing). An implications section applies particular attention to how fishermen approach their manners of work and recreation, and notes the potential utility of developing more exhaustive definitions for the descriptive categories typically used to manage the affairs of fishermen.

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